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ESSAYS

Of the

STRANGE SUBTILTY
GREAT EFFICACY
DETERMINATE NATURE

OF

EFFLUVIUMS.

To which are annext

NEW EXPERIMENTS

To make

FIRE and FLAME Ponderable:

Together with

A Discovery of the Perviousness of *GLASS*.

BY

The Honorable ROBERT BOYLE,
Fellow of the Royal Society.

— *Consilium est, universum opus Instaurationis* (*Philosophiæ*) *potius* promovere *in multis, quàm* perficere *in paucis.* Verulamius.

LONDON:
Printed by *W. G.* for *M. Pitt*, near the little North Door of St *Paul's* Church. 1673.

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An Advertiſement to the READER.

THIS hop'd, the Reader will not think it ſtrange, not to meet with in the following Papers a more cloſe and uniform contexture of the paſſages that make them up, if he be ſeaſonably inform'd of the riſe and occaſion of penning them, which was this. The Author having many years ago written an Eſſay about an Experiment he made of Nitre, by whoſe Phænomena he endeavour'd to exemplifie ſome parts of the Corpuſcular Philoſophy, eſpecially the Production of Qualities; he afterwards threw together divers occurring thoughts and experiments, which he ſuppos'd might be imployed by way of Notes, to prove or illuſtrate thoſe Doctrines, and eſpecially thoſe that concern'd the Qualities of Bodies; and among theſe

observing those that are call'd Occult, *to be Subjects uncultivated enough, (at least in the way that seem'd to him proper,) he propos'd to handle them more largely than most of the rest; and in order to that Design he judg'd it almost necessary, to premise some Considerations and experimental Collections* about *the Nature and power of Effluviums,* about *the Pores of Bodies and Figures of Corpuscles, and* about *the efficacy of such Local-motions as are wont either to be judged very faint, or to be pass'd by unheeded. For he had often look'd upon these three Doctrines, of* Effluvia, *of* Pores *and* Figures, *and of* Unheeded Motions, *as the three principal Keys to the Philosophy of Occult Qualities. But having hereupon made such Collections, as upon review appear'd too large to pass for Notes on so short a Text, he was induc'd to draw them * into the form (they now appear in) of* Essays; *but he would not put himself to the trouble of doing it, with care to keep them*

* And some that were publish'd *An.* 1669. under the Title of *The Atmospheres of consistent Bodies.*

them from retaining much of their first want of exact Method and Connexion. Nor was the Author solicitous to finish them up, in regard that his other Studies and occasions made him perceive, that in what he had design'd about Occult Qualities, he had cut himself out more work than probably he should during many years have opportunity to set upon in earnest, and complete. And in this Condition these Papers lay for divers years, (as is well known to several that saw them, or even transcrib'd some of them,) and might have continued to do so, if the Author had not been induc'd to let them come abroad, partly *by considering, that though the Subjects, (however he handled them) were as well important as curious, yet he did not find himself prevented by others in what he had to publish about them; and* partly *by the References he had made to them in some other Papers, that he had promised his Friends, wherein several things here deliver'd are vouched, and others suppos'd. And because the Notes concerning the Porosity of greater Bodies and the*

Figura-

Figurations of minute Particles, together with the Paper about unregarded Motions, having been long laid aſide among other neglected papers, were ſome of them miſſing, and others ſo mis-us'd, that they could not eaſily be made ready to accompany thoſe that now come abroad; the Author, that he might keep this Book from having its dimenſions too diſproportionate, was content to add to the thickneſs of it, by ſubjoyning one of thoſe little Tracts, that lay by him, concerning Flame, *becauſe of the Affinity betwixt the preceding Doctrine about* Effluviums *in general, and Experiments that ſhew in particular the Subtilty and the Efficacy of thoſe of Fire and Flame. And though, to that Tract it ſelf, there belong another, deſign'd to examine, Whether the matter of what we call the* Sun-beams, *may be brought to be ponderable; yet ſuppoſing this, hitherto cold and wet Summer, to be like to be as unfriendly to the Tryals to be made with Burning-glaſſes as of late years ſome other Summers have prov'd, he was eaſily prevail'd with, not to make thoſe Experiments*

ments that were ready, wait any longer for those, that probably will not in a short time be so; especially since those that now come abroad have no dependency upon the others.

OF

OF THE

Strange SUBTILTY OF EFFLUVIUMS:

BY

The Honorable ROBERT BOYLE.

LONDON:

Printed by *W. G.* for *M. Pitt* at the sign of the White Hart, over-against the little North Door of St *Paul*'s Church. 1673.

OF
The ſtrange SUBTILTY
OF
EFFLUVIUMS.

CHAP. I.

WHether we ſuppoſe with the Antient and Modern *Atomiſts*, that all ſenſible Bodies are made up of Corpuſcles, not only inſenſible, but indiviſible; or whether we think with the *Carteſians*, and (as many of that Party teach us) with *Ariſtotle*, that Matter, like Quantity, is indefinitely, if not infinitely diviſible: It will be conſonant enough

to either Doctrine, that the *Effluvia* of Bodies may conſiſt of Particles *extremely ſmall*. For if we embrace the Opinion of *Ariſtotle* or *Des-Cartes*, there is no ſtop to be put to the ſubdiviſion of Matter, into Fragments, ſtill leſſer and leſſer. And though the *Epicurean* Hypotheſis admit not of ſuch an *interminate* diviſion of Matter, but will have it ſtop at certain ſolid Corpuſcles, which for their not being further diviſible are called *Atoms* (Ἄτομοι;) yet the Aſſertors of theſe do juſtly think themſelves injured, when they are charged with taking the *Motes* or ſmall Duſt, that fly up and down in the Sun-Beams, for their Atoms; ſince, according to theſe Philoſophers, one of thoſe little grains of Duſt, that is viſible only when it plays in the Sun-Beams, may be compoſed of a multitude of Atoms, and exceed many thouſands of them in Bulk. This the Learned *Gaſſendus* in his Notes on *Diogenes Laertius* makes probable by the inſtance of a ſmall Mite, which, though ſcarce diſtinctly

distinctly discernable by the naked Eye, unless when 'tis in motion, does yet in a good Microscope appear to be a compleat Animal, furnished with all necessary Parts; which I can easily allow, having often in Cheese-Mites very distinctly seen the Hair growing upon their Legs. And to the former Instance I might add, what I have elsewhere told you of a sort of Animals far lesser than Cheese-Mites themselves, namely those that may be often-times seen in Vinegar. But what has been already said may suffice for my present purpose, which is only to shew, that the wonderful minuteness I shall hereafter ascribe to *Effluvia*, is not inconsistent with the most received Theories of Naturalists. For otherwise in this Essay the Proofs I mean to employ, must be taken, not *à Priori*, but *à Posteriori*. And the Experiments and Observations I shall employ on this occasion will be chiefly those, that are referrible to one of the following Heads.

I. *The ſtrange Extenſibility of ſome Bodies whilſt their Parts yet remain tangible.*

II. *The multitude of Viſible Corpuſcles, that may be afforded by a ſmall portion of Matter.*

III. *The ſmallneſs of the Pores at which the* Effluvia *of ſome Bodies will get in.*

IV. *The ſmall decrement of Bulk or Weight, that a Body may ſuffer by parting with great ſtore of* Effluvia.

V. *The great quantity of Space that may be fill'd, as to ſenſe, by a ſmall quantity of Matter when rarified or diſpers'd.*

But though to theſe diſtinct Heads I ſhall deſign diſtinct *Chapters*, yet you muſt not expect to find the Inſtances ſolicitouſly marſhall'd, but ſet down in the order they occurr'd to me; ſuch a liberty being allowable

This Eſſay was deſigned to be but a part of the Author's Notes upon his Eſſay about Salt-peter.

allowable in a Paper, where I pretend not to write *Treatiſes*, but *Notes*

CHAP. II.

AMong many things that are groſs enough to be the Objects of our Touch, and to be managed with our Hands, there are ſome that may help us to conceive a wonderful minuteneſs in the ſmall Parts they conſiſt of..

I do not remember what *Cardan*, and ſince him another Writer have deliver'd about the Thinneſs and Slenderneſs to which Gold may be brought. And therefore without poſitively aſſenting to, or abſolutely rejecting what may have been ſaid about it by others, I ſhall only borrow on this occaſion, what I have mention'd on another *In a Paper about* Improbable Truths, upon my own Obſervation; namely,

That Silver, whoſe Ductility and Tractility are very much inferiour to thoſe of Gold, was, by my procuring, drawn out to ſo ſlender a Wire, that, when we meaſur'd it, which was ſomewhat troubleſom to do, with a long and accurate meaſure, we found, that eight Yards of it did not yet fully counterpoiſe one Grain: So that we might add a Grain more without making the Scale, wherein 'twas put, manifeſtly preponderate, notwithſtanding the Tenderneſs of the Ballance. Whence we concluded, that a ſingle Grain of this Wire amounted to 27 Foot, that is, 324 Inches. And ſince Experience informs us, that half an *Engliſh* Inch can by Diagonal Lines be divided into 100 parts great enough to be eaſily diſtinguiſh'd, even for Mechanical uſes, it follows, that a Grain of this wire-drawn Silver may be divided into 64800 parts, and yet each of theſe will be a true metalline, though but ſlender and ſhort, Cylinder, which we may very well conceive to conſiſt

yet

yet of a multitude of minuter parts. For though I could procure no Gilt Wire near ſo ſlender as our newly mention'd Silver-wire; yet I tryed that ſome which I had by me was ſmall enough to make one Grain of it fourteen foot long: At which rate an Ounce did amount to a full Mile, conſiſting of 1000 Geometrical Paces, (of 5 foot a-piece,) and 720 foot over and above. And if now it be permitted to ſuppoſe the Wire to have been, as in probability it might have been, further drawn out to the ſame ſlenderneſs with the above-mention'd Silver-wire, the Inſtance will ſtill be far more conſiderable; for in this caſe, each of thoſe little Cylinders, of which 64800 go to the making of one Grain, will have a ſuperficial *Area*, which, except at the *Baſis*, will be cover'd with a Caſe of Gold; which is not only ſeparable from it by a mental Operation, but perhaps alſo by a Chymical one. For I remember, that from very ſlender gilt Wire, though I could get

none

none ſo ſlender as this of meer Silver, I did more than once, for Curioſities ſake, ſo get out the Silver, that the golden Films, whilſt they were in a Liquor that plumpt them up, ſeem'd to be ſolid wires of Gold: But when the Liquor was withdrawn, they appear'd, (as indeed they were) to be oblong and extremely thin and double Membranes of that Metal, which, with an Inſtrument that had been delicate enough, might have been ripp'd open, and diſplayed, and been made capable of further Diviſions and Subdiviſions. To this I ſhall add, that each of the little ſilver Cylinders I lately ſpake of, muſt not only have its little *Area*, but its Solidity; and yet I ſaw no reaſon to doubt, but that it might be very poſſible, if the Artificer had been ſo skilful and willing as I wiſh'd, to have drawn the ſame quantity of Metal to a much greater length, ſince even an Animal ſubſtance is capable of being brought to a ſlenderneſs much ſurpaſſing that of our Wire, ſuppoſing the Truth

of

of an Obſervation of very credible Perſons critical enough in making Experiments, which, for a Confirmation and an Improvement of our preſent Argument, I ſhall now ſubjoyn. An Ingenious Gentlewoman of my Acquaintance, Wife to a Learned Phyſician, taking much pleaſure to keep Silk-worms, had once the Curioſity to draw out one of the Oval Caſes, (which the Silk-worm ſpins, not, as 'tis commonly thought, out of its Belly, but out of the Mouth, whence I have taken pleaſure to draw it out with my Fingers,) into all the Silken-wire it was made up of, which, to the great wonder as well of her Husband, as her ſelf, who both inform'd me of it, appeared to be by meaſure a great deal above 300 Yards, and yet weigh'd but two Grains and a half: ſo that each Cylindrically ſhap'd Grain of Silk may well be reckon'd to be at leaſt 120 Yards long.

Another way, I remember, I alſo employed to help men by the extenſibility of Gold the better to conceive

the

the Minuteness of the Parts of Solid Bodies.

We took six beaten Leaves of Gold, which we measured one by one with a Ruler purposely made for nice Experiments, and found them to have a greater equality in Dimensions, and to be nearer true Squares, than could be well expected: The side of the Square was in each of them exactly enough three Inches and $\frac{1}{8}$, (or $\frac{1}{4}$,) which number being reduc'd to a Decimal Fraction, *viz.* $\frac{3125}{1000}$, and multiplied by it self, affords $\frac{10|15625}{1|0000}$ for the *Area*, or superficial Content of each square Leaf: And this multiplied by 6, the number of the Leaves, amounts to $\frac{6|1|17|50}{1|0|0|0}$ square Inches, for the *Area* of the six Leaves. These being carefully weigh'd in a pair of tender Scales, amounted all of them to one Grain and a quarter: And so one Grain of this foliated Gold was extended to somewhat above fifty Inches; which differ'd but about a fifth part from an Experiment of the like nature, that I remember I made many

many years ago in a pair of exact Scales; and ſo ſmall a difference may very well be imputed to that of the pains and diligence of the Gold-Beaters, who do not always work with equal ſtrength and skill, nor upon equally fine and ductile Gold.

Now if we recal to mind what I was lately ſaying of the actual diviſibility of an Inch into an hundred ſenſible parts, and ſuppoſe an Inch ſo divided to be applied to each ſide of a ſquare Inch of the Leaf-Gold newly mention'd, 'tis manifeſt that by ſubtle parallel Lines, drawn between all the oppoſite Points, a Grain of Gold muſt be diviſible into five hundred thouſand little Squares, very minute indeed, but yet diſcernible by a ſufficiently ſharp-ſighted Eye. And if we ſuppoſe an Inch to be divided into two hundred parts, as I lately told you it was in a Ruler I employ, then, according to the newly recited way, the number of the Squares, into which a ſingle Grain is capable of being divided, will amount to no leſs than two Millions. There

There is yet another way that I took to ſhew, that the extenſibility, and conſequently the diviſibleneſs of Gold is probably far more wonderful, than by the lately mention'd Tryal it appears.

For this purpoſe I went to a great Refiner, whom I uſed to deal with for purify'd Gold and Silver, and inquir'd of him, how many Grains of Leaf-Gold he was wont to allow to an Ounce of Silver, when it was to be drawn into gilt Wire as ſlender as an Hair? To this he anſwer'd me, that eight Grains was the proportion he allowed to an Ounce when the Wire was to be well gilt; but if it were to be more ſlightly gilt, ſix Grains would ſerve the turn. And to the ſame purpoſe I was anſwer'd by a skilful Wire-drawer. And I remember, that deſiring the Refiner to ſhew me an Ingot of Silver, as he did at firſt gild it; he ſhew'd me a good fair Cylindrical Bar, whereon the Leaf-Gold, that overlaid the ſurface, did not appear to be by

odds ſo thick as fine *Venetian* Paper; and yet comparing this with gilt Wire, which I alſo deſired to ſee, the Wire appeared to be the better gilt of the two; poſſibly becauſe the Gold in paſſing through the various Holes, was by the ſides of them not only extended but poliſhed, which made it look more vividly than the unpoliſh'd Leaves that gilded the Ingot.

So that, if we ſuppoſe an Ounce of the gilt Wire formerly mention'd to have been gilt with ſix Grains of Leaf-Gold, it will appear by an eaſie calculation, that at this rate one Ounce of Gold, employ'd on gilding Wire of that ſlenderneſs, would reach between ninety and an hundred Miles. But if now we further ſuppoſe, as we lately did, that the ſlender Silver-wire, mention'd at the beginning of this Chapter, were gilt; though we ſhould allow it to have (becauſe of its exceeding ſlenderneſs,) not, (as the former) 6 Grains, but 8 Grains of Leaf-Gold to an Ounce of Siver,

it

it muſt be acknowledged, that an hollow Cylinder or ſheath of Gold weighing but eight Grains, may be ſo ſtretch'd, that 'twill reach to no leſs than 60 times as much (in weight) of Silver-wire as it covers: [I ſaid 60 times, for ſo often is 8 contain'd in 480, the number of Grains in an Ounce;] and conſequently (a Grain of *that* Wire having been found to be 27 foot long,) the Ounce of Gold would reach to ſeven hundred ſeventy ſeven thouſand ſix hundred foot, that is, an hundred fifty five Miles and above a half. And if we yet further ſuppoſe this ſuperficial or hollow Cylinder of Gold to be ſlit all along, and cut into as ſlender liſts or thongs as may be, we muſt not deny that Gold may be made to reach to a ſtupendious length. But we need not this laſt ſuppoſition to make what preceded it an amazing thing: which yet though it be indeed Stupendious and *ſeem* Incredible, ought not at all to be *judg'd* Impoſſible; being no more than what upon the Suppo-

Suppoſitions and Obſervations above laid down, does evidently follow.

CHAP. III.

AFter what has been ſaid of the minuteneſs of *tangible* Objects, 'twill be proper to ſubjoyn ſome inſtances of the ſmallneſs of ſuch as yet continue *viſible*. But in regard theſe Corpuſcles are ſingly too little to have any common meaſure apply'd to any of them, we muſt make an eſtimate of their minuteneſs by the number of thoſe into which a ſmall portion or fragment of matter may be actually divided, the multitude of theſe being afforded by ſo inconſiderable a Quantity of matter, ſufficiently declaring, that each of them, in particular, muſt be marvelouſly little.

Among the inſtances, where the ſmallneſs of Bodies may be deduc'd from what is immediately the Object of Sight, it may not be unfit to take

notice of the evaporation of Water, which though it be granted to conſiſt of groſs particles in compariſon of the ſpirituous and odoriferous ones of divers other Liquors, as of pure Spirit of Wine, Eſſential Oyls of Spices, &c. yet to ſhew that a ſmall Quantity of it may be diſpers'd into a multitude of manifeſtly viſible Corpuſcles, I thought upon, and more than once try'd, the rarefaction of it into Vapors by help of an *Æolipile*, wherein, when I made the Experiment the laſt time, I took the pains to regiſter the Event as follows.

We put an Ounce of common Water into an *Æolipile*, and having put it upon a Chafing-diſh of coals, we obſerv'd the time when the ſtreams of Vapors began to be manifeſt. This ſtream was for a good while impetuous enough, as appear'd by the noiſe it made, which would be much increaſed, if we applied to it at a convenient diſtance a kindled brand, in which it would blow up the

the fire very vehemently. The ſtream continued about a quarter of an hour (ſixteen minutes or better,) but afterwards the Wind had pauſes and guſts for two or three minutes before it quite ceaſed. And by reaſon of the ſhape of the *Æolipile*, (which being fram'd chiefly for other purpoſes, was not ſo convenient for this) a great portion of the Vapors condens'd in the upper part of it, and fell down in drops; ſo that ſuppoſing that they alſo had come out in the form of Wind, and the blaſt had not been intermitted toward the latter end, I gueſs'd it might have continued uninterruptedly 18 or 20 minutes. *Note*, That applying a meaſure to the Smoak, that came out very viſible in a form almoſt conical, where it ſeem'd to have an Inch or more in Diameter, 'twas diſtant from the hole of the *Æolipile* about twenty Inches; and five or ſix Inches beyond that, though it were ſpread ſo much, as to have four or five Inches in Diameter, yet the not uniform

but ſtill-cohering Clouds (which was the form wherein the Vapors appear'd) were manifeſt and conſpicuous.

After the rarefaction of Water when 'tis turn'd into Vapors, we may conſider *that* of Fewel when 'tis turn'd into Flame; to which purpoſe I might here propoſe ſeveral Tryals as well of our own as others, about the prodigious Expanſion of ſome Inflammable Bodies upon their being actually turn'd into Flame. But in this place to mention all theſe, would perhaps too much intrench upon another Paper; and therefore I ſhall here propoſe to your conſideration but one inſtance, and that very eaſie to be tryed; of which I find this account among my *Adverſaria*.

Having oftentimes burnt Spirit of Wine, and alſo Oyl in Glaſs-lamps, that for certain uſes were ſo made, that the ſurface of the Liquor was ſtill circular, 'twas obvious to obſerve, how little the Liquor would ſub-

ſubſide by the waſt that was made of it, in about half a quarter of an hour. And yet if we conſider, that the naked Eye after ſome Exerciſe, may, as I have often tryed, diſcern the motions of a *Pendulum* that ſwings faſt enough to divide a ſingle minute of an hour into 240 parts, and conſequently half a quarter of an hour into 1800 parts; if we alſo conſider into how many parts of the time imployed by a *Pendulum*, the Vibrations, ſlow enough to be diſcernible by the Eye, may be mentally ſubdivided; and if we further conſider, that without intermiſſion, the Oyl is preyed upon by an actual Flame, and the particles of it do continually furniſh a conſiderable ſtream of ſhining matter, that with a ſtrange celerity is always flying away; we may very well conceive, that thoſe parts of Flame into which the Oyl is turned, are ſtupendiouſly minute, ſince, though the waſting of the Oyl is in its progreſs too ſlow to be perceived by the Eye, yet 'tis

undoubted that there is a continual decrement of the depth of the Oyl, the Phyſical ſurfaces whereof are continually and ſucceſſively attenuated and turn'd into flame; and the ſtrange ſubtilty of the Corpuſcles of flame would be much the ſtronglier argued, if we ſhould ſuppoſe, that inſtead of common Oyl the flame were nouriſh'd by a fewel ſo much more compact and durable, as is that inflammable ſubſtance made of a Metalline Body, of whoſe laſtingneſs I have elſewhere made particular mention, after having taught the way of preparing it.

In ſome Papers about Flame.

Having in a pair of tender Scales carefully weigh'd out half a Grain of good Gunpowder, we laid it on a piece of Tile, and whelm'd over it a veſſel of glaſs (elſewhere deſcrib'd, and often mention'd) with a Braſs-plate to cover the upper orifice of it. Then having fir'd the Gunpowder, we obſerv'd that the ſmoak of it did opacate, and as to ſenſe ſo fill the whole

whole cavity of the Glaſs, though its *Baſis* were eight inches, its perpendicular height above twenty inches, and its figure far more capacious than if it were conical; and this ſmoak, not containing it ſelf within the veſſel, iſſued out at two or three little intervals, that were purpoſely left between the orifice of the veſſel and the plate that lay upon it. This cover we then remov'd, that we might obſerve how long the ſmoak would continue to aſcend; which we found it would do for about half a quarter of an hour, and during near half that time, (*viz.* the three firſt minutes) the continually aſcending ſmoak ſeem'd to be, at its going out, of the ſame Diameter with the orifice at which it iſſu'd; and it would aſcend ſometimes a foot, ſometimes half a yard, ſometimes two foot or more into the Air, before it would diſperſe and vaniſh into it.

Now if we conſider, that the cavity of this round Orifice was two inches in Diameter, how many my-

riads of viſible Corpuſcles may we eaſily conceive throng'd out at ſo large an out-let in the time above-mention'd, ſince they were continually thruſting one another forwards? And into ſo many viſible Particles of ſmoak muſt we admit, that the half Grain of Powder was ſhatter'd, beſide thoſe multitudes, which, having been turn'd into actual flame, may probably be ſuppos'd to have ſuffer'd a comminution, that made them become inviſible. And though I ſhall not attempt ſo hopeleſs a work, as to compute the number of theſe ſmall Particles, yet to make an eſtimate whereby it would appear to be exceeding great, I thought fit to conſider, how great the Proportion was between the ſpaces, that to the Eye appear'd all full of ſmoak, and the dimenſions of the Powder that was reſolv'd into that ſmoak. Cauſing then the Glaſs to be fill'd with common Water, we found it to contain above two and twenty Pints of that liquor, and cauſing one of thoſe meaſures

meaſures to be weigh'd, it was found to weigh ſo near a pound (of ſixteen ounces,) that the computation of the whole Water amounted to at leaſt 160000 grains, and conſequently 320000 half grains. To which if we add, that this Gunpowder would readily ſink to the bottom of Water, as being (by reaſon of the Saltpeter and Brimſtone, that make up at leaſt ſix parts of ſeven of it) *in ſpecie* heavier than it, and in likelyhood twice as heavy, (for 'tis not eaſie to determine it exactly,) we may probably gueſs the ſpace to which the ſmoak reach'd to exceed 500000 times that, which contain'd the unfir'd Powder; and this, though the ſmoak, being confin'd in the veſſel, was thereby kept from diffuſing it ſelf ſo far as by its ſtreaming out it ſeem'd likely that it would have done.

To theſe Inſtances from Inanimate Bodies I ſhall ſubjoyn one more taken from Animals. Whereas then men have with Reaſon wonder'd, that ſo ſmall a Body as a Cheeſe-mite, which

which by the naked Eye is oftentimes not to be taken notice of, unleſs it move, (if even then it be ſo,) ſhould by the Microſcope appear to be an Animal furniſh'd with all neceſſary parts; whereas this, I ſay, has given juſt occaſion to conclude, that the Corpuſcles that make up the parts of ſo ſmall an Animal, muſt themſelves be extremely ſmall; I think the Argument may be much improved by the following Conſideration. Thoſe that have had the Curioſity to open from time to time Eggs that are ſat upon by a hatching Hen cannot but have obſerved, how ſmall a proportion in reference to the bulk of the whole Egg the Chick bears; when that, which the Excellent *Harvey* calls *Punctum ſaliens*, diſcloſes the motion of the Heart, and the colour of the Blood; and that even about the ſeventh or eighth day the whole Chick now viſibly form'd, bears no great proportion to the whole Egg, which is to ſupply it with Aliment, not only for its nouriſhment,

ment, but ſpeedy growth for many days after.

To apply this now to the matter in hand, having ſeveral times obſerved and ſhewn to others, that Cheeſe-mites themſelves are generated of Eggs, if we conceive, that in theſe Eggs, as in ordinary ones, the Animal at its firſt formation bears but a ſmall proportion to the bulk of the whole Egg, the remaining part being to ſuffice for the food and growth of the *Embryo* probably for a pretty while; ſince, if an Ingenious perſon, that I deſired to watch them, did not mis-inform me, they uſed to be about ten or twelve days in hatching; this whole Egg it ſelf will be allowed to be but little in reference to the Mite it came from, how extremely and unimaginably minute may we ſuppoſe thoſe parts to be, that make up the Alimental Liquors, and even the Spirits, that paſſing through the Nerves or Analogous parts, ſerve to move the Limbs and Senſories of but, as it were, the

the Model of ſuch an Animal, as, when it reſts, would not (perhaps) it ſelf to the naked Eye be ſo much as viſible; and in which we may preſume the nobler ſort of ſtabler parts to be of an amazing ſlenderneſs, if we conſider, that, though in other hairy Animals, the Optick or ſome other of the larger Nerves do, I know not how many times, in thickneſs and circuit ſurpaſs a hair of the ſame Animal; yet in a Cheeſe-Mite, though none of the largeſt of thoſe Creatures, we have divers times manifeſtly ſeen, as is before intimated, ſingle Hairs that grow upon the Legs.

Another way there is, that I imployed to give men cauſe to think, that the inviſible *Effluvia* of Bodies that wander through the Air may be ſtrangely minute; and this was, by ſhewing how ſmall a fragment of matter may be reſolved into particles minute enough to aſſociate themſelves in ſuch numbers with a Fluid ſo much more denſe than Air, as Water

Water is, as to impart a determinate Colour to the whole liquor. What I did with *Cocheneel* in proſecution of this deſign, my Experiments about *Colours* may inform you; but I ſhall now relate the ſucceſs of an attempt made another way, for which perhaps ſome of your friends the Chymiſts will thank me; though I was not ſolicitous to carry on the Experiment very far with Gold, not becauſe I judged that leſs diviſible into a number of colour'd particles, but becauſe I found, as I expected, that the paleneſs of the native colour of the Gold may make it in the end leſs conſpicuous, though, if I had then had by me a *Menſtruum*, as I ſometimes had, that would diſſolve Gold blood-red, perhaps the experiment with Gold would have ſurpaſs'd that, which 'tis now time I ſhould begin to relate, as ſoon as I have hinted to you by the way, that, for varieties ſake, I made a tryal with Copper calcin'd *per ſe*, that I might not be accuſed of having omitted to employ

employ a Metal whose Body Chymists suppose to be much opened by Calcination. And though the event were notable even in Comparison of that of the experiment made with *Cocheneel*, yet my conjectures inclin'd me much to preferr the way describ'd in the following Account.

We carefully weigh'd out in a pair of tender Scales one grain of Copper not-calcin'd, but barely fil'd; and because, as we made choice of this Metal for its yielding in most *Menstruums* a Blew, which is a deep and conspicuous colour; we also chose to make a solution, not in *Aqua fortis* or *Aqua regis*, but the Spirit of *Sal Armoniack* (as that is an urinous Spirit,) having found by former tryals, that this *Menstruum* would give a far deeper solution than either of the others. This lovely Liquor, of which we us'd a good proportion, that all the Copper might be throughly dissolved, we put into a tall cylindrical Glass of about four inches in Diameter, and by degrees pour'd to it of distill'd Water,

Water, which is more proper in this caſe than common Water, which has oftentimes an inconvenient Saltiſhneſs, 'till we had almoſt fill'd the Glaſs, and ſaw the colour grow ſomewhat pale, without being too dilute to be manifeſt; and then we warily pour'd this liquor into a conical Glaſs, that it might be the more eaſie to fill the veſſel ſeveral times to the ſame height. This conical Glaſs we filled to a certain mark four times conſecutively, weighing it, and the liquor too, as often in a pair of excellent Scales purpoſely made for Statical experiments, and which, though ſtrong enough to weigh ſome pounds in each Scale, would, when not too much loaden, turn with about one grain. Theſe ſeveral weights of the Glaſs, together with the contained liquor, we added together, and then carefully weighing the empty Glaſs again, we deducted four times its weight from the above-mentioned ſumm, and thereby found the weight of the liquor alone, to be that, which

reduc'd

reduc'd to grains amounted to 28534; ſo that a grain of Copper, which is not full half ſo heavy *in ſpecie* as fine Gold, communicated a Tincture to 28534 times its weight.

But now if you pleaſe to take notice, that the ſcope of my Experiment was to ſhew, into what a number of parts one grain of Copper might be divided, you will allow me to conſider, as I did, that this multitude of parts muſt be eſtimated by the Proportion, not ſo much in weight as in bulk, of the tinging Metal to the tinged Liquor, and conſequently, ſince that divers Hydroſtatical tryals have inform'd me, that the weight of Copper to the weight of Water of the ſame bulk is *proximè* as 9 to 1, a grain-weight of Copper is in bigneſs but the ninth part of as much Water as weighs a grain; and ſo the formerly mention'd number of the grains of Water muſt be multiplied by 9, to give us the Proportion between the tinging and tinged Bodies, that is, that a ſingle grain of Copper

Copper gave a blewneſs to above 256806 parts of limpid Water, each of them as big as it. Which, though it may ſeem ſtupendious, and ſcarce credible; yet I thought fit to proſecute the Experiment ſomewhat farther, by pouring all the liquor out of the tall cylindrical Glaſs into another clean veſſel, whence filling the conical Glaſs twice, and emptying it as often into the ſame cylindrical Glaſs, the third time I fill'd the conical Glaſs with colourleſs diſtill'd Water, and pouring that alſo into the cylindrical Glaſs, we found the mixt liquor to have yet a manifeſt, though but a pale, blewneſs. And, laſtly, throwing away what was in the cylindrical Glaſs, we poured into it, out of the ſame conical Glaſs, equal parts of diſtill'd colourleſs Water, and of the tincted Liquor we had formerly ſet apart in the clean Veſſel, and found, that, though the colour were very faint and dilute, yet an attentive Eye could eaſily diſcern it to be blewiſh; and ſo it was judg'd

by an intelligent Stranger that was brought in to look upon it, and was deſir'd to diſcover of what colour he thought it to be. Whereby it appears, that one grain of Copper was able to impart a colour to above double the quantity of Water above mentioned.

This Experiment I have allow'd my ſelf to be the longer and more particular in relating, both becauſe I know not, that any ſuch has been hitherto either made or attempted, and becauſe it will probably gratifie your Chymiſts, that love to have the Tinctures of Metals believ'd very diffuſive; and becauſe, if Circumſtances were not added, it would ſeem to you as well incredible, as perhaps it does ſeem ſtupendious, that a portion of matter ſhould be able to impart a *conſpicuous* colour to above 256806 times its bulk of Water, and a manifeſt tincture to above 385200, (for ſo it did, when the proportion of the ting'd part to the whole mixture, made of it and the unting'd part,

part, was as 2 to 31,) and a faint, but yet *discernible* and distinguishable colour to above five hundred and thirteen thousand six hundred and twenty times its bulk of Water.

CHAP. IV.

IT were easie for me (*Pyroph.*) to give you several Instances, to shew, that the *Effluvia* of *Liquors* may get in at the Pores of Bodies that are reputed of a close Texture, but I shall at present forbear to mention such Examples, not only because they belong to another place*, where I take notice of them, but because many such would not seem so remarkable, nor be so considerable to our present purpose, as a few taken from Bodies that are *not Fluid*.

* *A Discourse of Pores of Bodies, and Figures of Corpuscles.*

And first, it is deliver'd by Writers

of good credit, that ſeveral Perſons, (for the Experiment does not hold in all) by barely holding for ſome time dryed *Cantharides* in their hands, have been put to much pain at the neck of the Bladder, and have had ſome other parts miniſtring to the ſecretion of Urine ſenſibly injured. That this is true, I am induced to believe, by what I have elſewhere related to you of the unwelcome experiment I had of the effect of *Cantharides* applied but outwardly to my neck, and that unknown to me, upon the Urinary Paſſages; and that theſe Operations are due to material Effluxes, which, to get into the Maſs of Blood, muſt paſs through the pores of the skin, you will not, I preſume, put me to prove.

Scaliger Exercit. 186. relates, that n *Gaſcony*, his Countrey, there are Spiders of that virulency, that, if a man treads upon them to cruſh them, their poyſon will paſs through the very ſoles of his Shooes. Which ſtory, notwithſtanding the Reputation

of

of the Author, I ſhould perhaps have left unmention'd, becauſe of a much ſtranger about Spiders, which he relates in the ſame Section, but that I met with one that is analogous in the diligent *Piſo*'s late Hiſtory of *Braſile*; where, having ſpoken of another venemous Fiſh of that Country, and the Antidotes he had ſucceſsfully uſed to cure the hurts it inflicts, he proceeds to that Fiſh the Natives call *Amoreatim*, of one kind whereof, call'd by the *Portugals Peize Sola*, his words are theſe; *Quæ mira ſanè efficacia non ſolum manum vel leviſſimo attactu, ſed & pedem, licet optimè calceatum, Piſcatoris incautè piſciculum conterentis, Paralyſi & Stupore afficit, inſtar Torpedinis Europæ, ſed minus durabili.* Lib. 5. cap. 14.

What I ſhall ere long have occaſion to tell you of the power of the *Torpedo*, and ſome other Animals, to affect the Hand and Arm of him that ſtrikes them, ſeems applicable to the matter under conſideration: For, though their affecting the ſtriker at

a diſtance, may very well be aſcrib'd to the ſtupefactive or other venemous Exhalations that expire (and perhaps are as it were darted) from the Animal irritated by the ſtroke, and are breath'd in together with the air they infect; yet their benumming, or otherwiſe affecting the Arm that ſtruck them, rather than any other part, ſeems to argue, that the poyſonous ſteams get in at the pores of the skin of the Limb, and ſo ſtupifie, or otherwiſe injure, the nervous and muſculous parts of it.

Other Examples belonging to this Section may be referr'd hither from divers other places in theſe Papers about Occult Qualities, and therefore I ſhall only add here that moſt remarkable Proof, *That ſome Emanations, even of ſolid Bodies, may be ſubtil enough to get through the pores, even of the cloſeſt Bodies*; which is afforded us by the *Effluvia* of the Loadſtone, which are by Magnetical Writers ſaid to penetrate without reſiſtance all kind of Bodies. And though

though I have not tryed this in all ſorts, yet having tryed it in Metals themſelves, I am apt to think, the general Rule admits of very few Exceptions, eſpecially, if that can be fully made out, which is affirm'd about the perviouſneſs of Glaſs to the Effluxions of the Loadſtone. For, not only Glaſs is generally reputed to be as cloſe a Body as any is, but (which weighs more with me) I have by Tryals purpoſely made, had occaſion to admire the cloſeneſs of very thin pieces of Glaſs. But the reaſon why I juſt now expreſs'd my ſelf with an *If*, was, becauſe I was not entirely ſatisfied with the Proof wont to be acquieſc'd in, of the perviouſneſs of Glaſs; namely; that in Dials and Sea-Compaſſes that are cover'd with plates of Glaſs, the Needle may be readily moved to and fro by a Loadſtone held over it. For theſe Plates being commonly but faſten'd on with Wax, or at beſt with Cement, a Sceptick may pretend, that the magnetical *Effluvia*

paſs not through the Glaſs, but through that much more pervious matter, that is imployed to ſecure the Commiſſures, only from the acceſs of the Air. To put then the matter paſt doubt, I cauſed ſome Needles to be Hermetically ſeal'd up in Glaſs-pipes, which being laid upon the ſurface of water (whereon by reaſon of the bigneſs of the Cavities they would lightly float,) the included Needles did not only readily feel the virtue of an externally applied Loadſtone, (though but a weak one) but complied with it ſo well, that I could eaſily, by the help of the Needle, lead, without touching it, the whole Pipe, this was ſhut up in, to what part of the ſurface of the water I pleaſed. And I alſo found, that by applying a better Loadſtone to the upper part of a ſealed Pipe, and a Needle in it, I could make the Needle leap up from the lower part as near to the Loadſtone as the interpoſed Glaſs would give it leave.

But I thought it would be more conſiderable, to manifeſt that the

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Magnetical *Effluvia*, even of ſuch a dull Body, as the Globe of the Earth, would alſo penetrate Glaſs. And though this ſeem difficult to be tryed, becauſe no ordinary Loadſtone, nor any Iron touch'd by it, was to be imployed to work on the included Iron; yet I thought fit to attempt it after this manner: I took a cylindrical piece of Iron of about the bigneſs of ones little finger, and between half a foot and a foot long, (for I had formerly obſerved, that the quantity of unexcited Iron furthers its Operation upon excited Needles,) and having Hermetically ſeal'd it up in a Glaſs-pipe but very little longer than it; I ſuppoſed, that if I held it in a perpendicular poſture, the Magnetical *Effluvia* of the Earth, penetrating the Glaſs, would make the lower extreme of the Iron anſwerable to the North Pole; and therefore having applied this to the point of the Needle in a Dial, or Sea-Compaſs, that look'd toward the North, (for Authors mean not all the ſame thing by the

the Northern Pole of a Needle or Loadſtone,) I preſum'd it would, according to the Laws Magnetical (elſewhere mention'd) drive it away, which accordingly it did. And having for farther tryal inverted the included Iron, (ſo that the end which was formerly the lowermoſt, was now the uppermoſt) and held it in a perpendicular poſture juſt under the ſame point of the Needle, that extreme of the Iron-rod, which before had driven away this point, being by this inverſion become (in a manner) a South-Pole, did (according to the ſame Laws) attract it: By which ſudden change of Poles, meerly upon the change of ſituation, it alſo appear'd, that the Iron ow'd its Virtue only to the Magnetiſm of the Earth, not that of another Loadſtone; which would not have been thus eaſily alterable. And this Experiment I the more particularly relate, becauſe this is not the only place, where I have occaſion to make uſe of it.

CHAP.

CHAP. V.

ANother proof of the great Subtilty of *Effluviums*, may be taken from the ſmall Decrement of weight or bulk that a Body may ſuffer by parting with great ſtore of ſuch Emanations.

That Bodies, which infus'd in Liquors impregnate them with new Qualities ſuitable to thoſe of the immers'd Bodies, do ſo by imparting to them ſomewhat of their own Subſtance, will, I preſume, be readily granted by thoſe that conceive not, how one Body ſhould communicate to another a ſolitary and naked Quality, unaccompanied by any thing Corporeal to ſupport and convey it. But I would not have you think, *Pyrophilus*, that the only matter of fact I have to countenance this notion, is that Experiment, which has convinc'd divers Chymiſts and Phyſicians, otherwiſe not

not friends to the Corpuſcular Philoſophy, that Medicines may operate without any conſumption of themſelves. For, *though* divers of theſe, ſome of them Learned men, have confidently written, that *Glaſs of Antimony* and *Crocus Metallorum*, being either of them infus'd in a great proportion of Wine, will make it vomitive; and if that liquor be poured off, and new be poured on, every new portion of ſuch liquor will be impregnated with the ſame virtue, and this though the liquor be chang'd a thouſand times, and yet the *Antimonial Glaſs* or *Crocus* will continue the ſame as well in weight as virtue; and *though* thence ſome of them, eſpecially Chymiſts, argue, that ſome Metals without imparting any thing ſubſtantial, but only, as *Helmont* ſpeaks of ſome of his *Arcana*, by irradiation: *Yet*, I confeſs, I have ſome doubts, whether the Experiment have been competently tryed, and ſhall not fully acquieſce in what has been ſaid, till ſome skilful Experimenter deliver it upon his

own

own Tryal, and acquaint us too, with what Inſtruments and what Circumſpection he made it. For, beſides that the Ingenioufeſt Phyſicians I have queſtion'd about it, acknowledg'd the Taſt, and ſometimes the Colour of the Wine to be alter'd by the infus'd Mineral, I could not acquieſce in the affirmation of an ordinary Chymiſt or Apothecary, or even Phyſician, if he ſhould barely averr, that he had weigh'd an Antimonial Medicine before 'twas put to infuſe, and after the infuſion ended, and obſerv'd no decrement of weight. For I have had too much experience (as I elſewhere mention) of the difficulty of making exact Statical tryals; not to know, that ſuch Scales, as are wont to be imployed by Chymiſts and Apothecaries in weighing Drugs, are by no means fit to make tryals with the nicety which that I am ſpeaking of requires: It being eaſie, even with the better ſort of ſuch unaccurate Scales, eſpecially if they be not ſuſpended from ſome fixt thing, but

but held with the hand, to miſtake half a grain or a grain; and perhaps a greater quantity, and at leaſt more than by divers of the Experiments of this Eſſay appears neceſſary to be ſpent upon the impregnating of a conſiderable proportion of Liquor with Corporeal Effluxions. Beſides, that if, when the beaten *Crocus* or *Glaſs* be taken out of the Wine to be weigh'd again, the Experimenter be not cautious enough to make allowance for the Liquor that will adhere to the Medicament, 'tis plain that he may take notice of no decrement of weight, though there may be really *Effluviums* of the Mineral amounting to ſeveral grains, imbib'd by the Liquor. And though he be aware of this, and dry the powder, yet 'tis not ſo eaſie, even for a skilful man, to be ſure that none of the more viſcous particles of the Liquor ſtick to the Mineral, and being ſenſible upon the Ballance, though not to the Eye or Hand, repair the receſs of thoſe emetick Corpuſcles that diffus'd them-

themſelves into the *Menſtruum*. And the ſenſe of theſe difficulties put me upon the attempting to make ſo noble an Experiment with excellent Scales, and the care that it deſerves: But after a long tryal, an unlucky accident fruſtrated at laſt my endeavours. But though, till competent Relators give us an account of this matter upon their own tryal, and repeat the Infuſion very much oftener, than, for ought I find, any man has yet done, I muſt not acquieſce in all that is ſaid of the Impregnation of Wine or other Liquors by *Antimonial Glaſs* and *Crocus Metallorum*; yet that after divers repeated Infuſions the Mineral ſubſtance ſhould not be ſenſibly diminiſh'd in bulk or virtue, may well ſuffice to make this Inſtance, though not the only or chief that may be brought for our purpoſe, yet a pertinent one to it. For that there is a powerful Emetick Quality imparted to the Liquor, is manifeſt by experience; and that the Mineral does not impart this virtue

as

as 'twere by irradiation, but by ſubſtantial effluxion, ſeems to me very probable; not only becauſe I conceive not, how this can be done otherwiſe, but becauſe, as 'tis noted above, the Wine does oftentimes change colour by being kept a competent time upon the Mineral, as if it drew thence a Tincture; and even when it is not diſcolour'd, I think it unſafe to conclude, that the *Menſtruum* has not wrought upon it. For I have kept good Spirit of Vinegar for a conſiderable time upon finely powder'd Glaſs of Antimony made *per ſe*, without finding the Spirit to be at all ting'd, though 'tis known, that Antimonial Glaſs is ſoluble in Spirit of Vinegar, as mine afterwards appear'd to be, by a longer digeſtion in the ſame Liquor. But there may be a great number of minute particles diſſolved in the *Menſtruum* before they be numerous enough to change the Colour of it. And with this agrees very well what is obſerv'd, That though too great a quantity of the pre-

prepar'd Antimony be put into the liquor, yet it will not be thereby made too ſtrongly Emetick. For the Wine, being a *Menſtruum*, will, like other *Menſtruums*, be impregnated but to a certain meaſure, without diſſolving the overplus of the matter that is put into it. And *Mars*, which is a harder and heavier body than Glaſs of Antimony, is it ſelf in part ſoluble in good *Rheniſh* or other white Wine, (and that in no long time,) and ſometimes even in Water.

I do not therefore reject the Emetick Infuſion, as unfit to have a place in this Chapter, but till the experiment have been a little more accurately made, I think it inferiour, as to our purpoſe, to ſome of the Inſtances to be met with in the next Chapter, and perhaps alſo to that mention'd by *Helmont*, and tryed by more than one of my Acquaintance, concerning the Virtue of killing Worms, that Mercury imparts to the water or wine wherein it has been long enough infus'd, or elſe for

a while decocted. Though Quick-ſilver given in ſubſtance is commended as an effectual Medicine againſt Worms, not only by many profeſt * Spagyriſts, but by divers ** Methodiſts of good Note. And though, ſome other things, Chymical and Philoſophical, keep me from being of their opinion, who think that in this caſe the Mercury impregnates the liquor as it were by Irradiation, rather than in a Corporeal manner, yet the Eye does not perceive, that even limpid water takes any thing from clean and well purg'd Mercury, which we know that divers corroſive liquors themſelves will not work upon.

* As *Quercetanus, Libavius, Zabata, Burggravius.*

** As *Vidius, Paræus, Caſalpinus*, &c.

To this Inſtance I muſt add one that is yet freer from exceptions, which is, that having for Curioſity ſake ſuſpended in a pair of exact Scales, that would turn with a very ſmall part of a grain, a piece of *Amber-greece* bigger than a Walnut, and

and weighing betwixt an hundred and ſix-ſcore grains, I could not in three days and a half that I had opportunity to make the tryal, diſcover, even upon that Ballance, any decrement of weight in the *Amber-greece*; though ſo rich a perfume, lying in the open Air, was like in that time to have parted with good ſtore of odoriferous Steams. And a while after ſuſpending a Lump of *Aſſa fœtida* five days and a half, I found it not to have ſuſtain'd any diſcernible loſs of weight, though, in ſpite of the unfavourable cold weather, it had about it a neighbouring Atmoſphere repleniſh'd with fœtid exhalations. And when twelve or fourteen hours after, perhaps upon ſome change of weather, I came to look upon it, though I found that in that time the *Æquilibrium* was ſomewhat alter'd, yet the whole Lump had not loſt half a quarter of a grain; which induc'd me to think, that there may perhaps be Steams diſcernible even by our Noſtrils, that are far more ſubtil than the odorous

exhalations of Spices themſelves. For, having in very good Scales ſuſpended in the Month of *March* an ounce of Nutmegs, it loſt in about ſix days five grains and a half. And an ounce of Cloves in the ſame time loſt ſeven grains and five eigths.

You will perhaps wonder, why I do not preferr to the Inſtances I make mention of in this Chapter, that which may be afforded by the Loadſtone, that is acknowledg'd continually to emit multitudes of Magnetical Steams without decrement of weight. But though I have not thought fit to paſs this wholly under ſilence; yet I forbear to lay ſo much ſtreſs on it, not only becauſe my Ballances have not yet ſatisfied me about the *Effluvia* of Loadſtones, (for I take them not all to be equally diffuſive of their Particles;) but becauſe I foreſee it may be doubted, *whether* Loadſtones, like odorous Bodies, do furniſh afreſh of their own, all the Corpuſcles that from time to time iſſue from them? *Or*, whether they

they be not continually repaired, *partly* by the return of the Magnetical Particles to one Pole that ſallied out of the other; and *partly* by the continued paſſage of Magnetical matter (ſupplied by the Earth or other Mundane Bodies) it make the Pores or Channels of the Loadſtone their conſtant Thorow-fares.

I doubt not but it will make it more probable, that a ſmall Quantity of matter being ſcatter'd into inviſible *Effluvia* may be exceedingly rarified and expanded, if it can be made appear, that this little portion of matter ſhall, for a conſiderable time, emit multitudes of viſible parts, and that in ſo cloſe an order among themſelves, as to ſeem in their Aggregate but one intire liquor, endow'd with a ſtream-like motion, and a diſtinct *ſuperficies*, wherein no interruption is to be ſeen, even by an Eye plac'd near it. To deviſe this Experiment, I was induc'd, by conſidering, that hitherto all the (total) diſſolutions that have been made of

Pigments, have been in liquors naturally cold, and conſiſting probably of much leſs ſubtile, and certainly of much leſs agitated parts, than that fluid aggregate of ſhining matter that we call *Flame*; whereas I argued, that if one could totally diſſolve a Body compos'd of parts ſo minute as thoſe of a Metal into actual Flame, and husband its Flame ſo, as that it ſhould not immoderatly waſte, I ſhould thereby diſſolve the Metal in a far more ſubtil *Menſtruum* than our common water, or *Aqua fortis*, or *Aqua Regis*, or any other known *Menſtruum* I have yet imployed. And conſequently the attenuation and expanſion of the Metal in this truly Igneous *Menſtruum* would much ſurpaſs not only what happens in ordinary Metalline ſolutions, but poſſibly alſo what I have noted in the third Chapter of this *Eſſay*, about the ſtrange diffuſion of Copper diſſolv'd in Spirit of Urine and Water. In proſecution of this deſign, I ſo prepar'd one ſingle grain of that Metal,

Metal, by a way that I elſewhere teach, that it was diſſolv'd in about a ſpoonful of an appropriated *Menſtruum*. And then having caus'd a ſmall Glaſs-lamp to be purpoſely blown to contain this liquor, and fitted it with a ſocket and wieck, we lighted the Lamp, which, without conſuming the wieck, burnt with a flame large enough and very hot, and ſeem'd to be all the while of a greeniſh blew, as if it were a but finer and ſhining ſolution of Copper. And yet this one grain of prepar'd Metal ting'd the flame that was from moment to moment produc'd, during no leſs than half an hour and ſix minutes. And now if we conſider, that in this flame there was an uninterrupted Succeſſion of multitudes of colour'd Particles newly extricated, and flying off in every of thoſe many parts wherein a minute of time may either actually or mentally be divided; *and*, if we conſider Flame as a light and very agitated body, paſſing with a ſtream upwards through the Air;

and if we also consider the quantity of liquor that would (as I shall by and by tell you) run through a Pipe of a much lesser diameter than that Flame, within the compass of the forementioned time: What a quantity of the streaming fluid we call Flame, if it could have been preserv'd and collected into one Body, may we suppose would appear to have issued out of one grain of Copper in the space of thirty-six minutes; and what a multitude of metalline Corpuscles may we suppose to have been supplied for the tinging of that Flame during so long a time? since a Cylindrical stream of water falling but through a very short Pipe of glass, constantly supplied with liquors, did pass at such a rate, that, though the aqueous Cylinder seem'd more slender by half, (or perhaps by two thirds or better) than the Flame, yet we estimated, by the help of a Minute-watch and a good pair of Scales, that, if I had had conveniencies to let it run long enough, the water efflux'd in thirty-

six

ſix minutes (the time of the Flames duration) would have amounted to above nine gallons, or, (reckoning a pint of water to contain a pound of ſixteen ounces) ſeventy-two pounds.

CHAP. VI.

THE laſt ſort of Inſtances I ſhall propoſe to ſhew the ſtrange Subtilty of *Effluvia*, is of ſuch, as diſcover the great quantity of ſpace that may by a ſmall quantity of matter, when rarified or diſpers'd, be either fill'd as to ſenſe, or, at leaſt, made (as they ſpeak) the ſphear of its activity.

To manifeſt this Truth, and thereby as well confirm the foregoing Chapter, as make out what is deſign'd in this, I ſhall endeavour to ſhew, and help your imagination to conceive, how great a ſpace may be impregnated with the Effluxions of a Body, oftentimes without any ſenſible, and oftener without any conſiderable decrement

crement in bulk or weight of the Body that affords them. And in order to this, though I ſhall not pretend to determine preciſely how little the ſubſtances, I am to inſtance in, would waſte upon the Ballance, becauſe you will very eaſily ſee they are not that way to be examin'd; yet I preſume, you will as eaſily grant, that the decrement of weight would be but inconſiderable, ſince of ſuch light ſubſtances the loſs even of bulk is ſo; which laſt clauſe I ſhall now attempt to make good, by ſetting down ſome Obſervations, partly borrow'd from the writings of approv'd Phyſicians, and partly that my friends and I have made about the durable Evaporation of ſuch ſmall particles of the Effluxions of Animals, as are actually not to be diſcern'd by the Eye to have any of thoſe things ſticking to them, which are ſo very long in flying ſucceſſively away.

'Tis wont to be ſomewhat ſurprizing to men of Letters, when they firſt go a hawking with good Spaniels,

niels, to obſerve, with how great ſagacity thoſe dogs will take notice of, and diſtinguiſh by the ſcent, the places where Partridges, Quails, *&c.* have lately been. But I have much more wonder'd at the quick ſcent of an excellent Setting-dog, who by his way of ranging the fields, and his other motions, eſpecially of his Head, would not only intimate to us the kinds of game, whoſe ſcent he chanc'd to light on, but would diſcover to us where Partridges had been (though perhaps without ſtaying in that place) ſeveral hours before, and aſſiſt us to gueſs how long they had been gone before we came.

I have had ſtrange anſwers given me in *Ireland*, by thoſe who make a gain if not an intire livelihood by killing of Wolves in that Countrey, (where they are paid ſo much for every head they bring in) about the ſagacity of that peculiar race of dogs they imploy in hunting them; but not truſting much to thoſe Relators, I ſhall add, that a very ſober and

diſcreet

diſcreet Gentleman of my acquaintance, who has often occaſion to imploy Blood-hounds, aſſures me, that if a man have but paſs'd over a field, the ſcent will lye (as they ſpeak) ſo as to be perceptible enough to a good dog of that ſort for ſeveral hours after. And an ingenious Hunter aſſures me, that he has obſerv'd, that the ſcent of a flying and heated Deer will ſometimes continue upon the ground from one day to the next following.

And now we may conſider theſe three things; *Firſt*, That the ſubſtance left upon the graſs or ground by the tranſient tread of a Partridge, Hare, or other *animal*, that does but paſs along his way, does probably communicate to the graſs or ground but ſome of thoſe Effluxions, that tranſpire out of his feet, which being ſmall enough to eſcape the diſcernment of the Eye, may probably not amount to one grain in weight, or perhaps not to the tenth part of it. *Next*, That the parts of fluid Bodies,

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as ſuch, are perpetually in motion, and ſo are the inviſible particles that ſwim in them, as may appear by the diſſolution of Salt or Sugar in water, and the wandering of aqueous Vapours through the Air, even when the Eye perceives them not. And *thirdly*, That though the Atmoſphere of one of theſe ſmall parcels of the exhaling matter we are ſpeaking of, may oftentimes be exceeding vaſt in compariſon of the emittent Body, as may be gueſs'd by the diſtance, at which ſome Setters, or Blood-hounds, will find the ſcent of a Partridge, or Deer; yet in places expos'd to the free air or wind, 'tis very likely that theſe ſteams are aſſiduouſly carried away from their Fountain, to maintain the fore-mention'd Atmoſphere for ſix, eight, or more hours, that is, as long as the ſcent has been obſerv'd to lye, there will be requiſite a continual recruit of ſteams ſucceeding one another: And that ſo very ſmall a portion of matter as that which we were ſaying

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ing the *fomes* of theſe ſteams may be judg'd to be, being ſenſibly to impregnate an Atmoſphere incomparably greater than it ſelf, and ſupply it with almoſt continual recruits, we cannot but think, that the ſteams it parts with, muſt be of an extreme and ſcarce conceivable minuteneſs.

And we may further conſider, that the ſubſtances, which emit theſe ſteams, being ſuch as newly belong'd to Animals, and were, for the moſt part, tranſpir'd through the pores of their feet, muſt be in likelihood a far more evaporable and diſſipable kind of Bodies than Minerals or aduſt Vegetables, ſuch as Gunpowder is made of; ſo that if the grains of Gunpowder emit Effluviums capable of being by ſome Animals perceiv'd at a diſtance by their ſmell, one may probably ſuppoſe, that the ſmall grains of this powder may hold out very many times longer to ſupply an Atmoſphere with odorable ſteams, than the Corpuſcles left on the

the ground by tranſient Animals.

Now though it be generally agree'd on, that very few Birds have any thing near ſo quick a ſenſe of ſmelling as Setting-dogs or Blood-hounds, yet that the odour of Gunpowder, eſpecially when aſſiſted by the ſteams of the *Caput mortuum* of Powder formerly fir'd in the ſame Gun, may by Fowls be ſmelt at a notable diſtance, particularly when the wind blew from me towards them, I often perſwaded my ſelf I obſerv'd, eſpecially as to Crows, when I went a ſhooting; and was confirm'd in that opinion, both by the common Tradition, and by ſober and ingenious perſons much exercis'd in the killing of Wild-fowl, and of ſome fourfooted Beaſts.

I had forgotten to take notice of one Obſervation of the experienc'd *Julius Palmarius*: Whence we may learn, that Beaſts may leave upon the Vegetables, that have touch'd their bodies for any time, ſuch Corpuſcles, as, though unheeded by other

other Animals, may, when eaten by them, produce in them ſuch diſeaſes as the infected Animals had. For this Author writes in his uſeful Tract *de morbis Contagioſis*, that he obſerv'd Horſes, Beeves, Sheep and other Animals, to run mad upon the eating of ſome of the ſtraw on which ſome mad Swine had layn.

And now to reſume and proſecute our former diſcourſe, you may take notice, that the *Effluvia*, mention'd to have been ſmelt by Animals, are, though inviſible, yet big enough to be the objects of ſenſe; ſo that 'tis not improbable, that, among the ſteams that no ſenſe can immediately perceive, there ſhould be ſome far more ſubtil than theſe, and conſequently capable of furniſhing an Atmoſphere much longer, without quite exhauſting the effluviating matter that afforded them.

* *Foreſtus*, an uſeful Author, recites an Example of Peſtilential contagion long preſerv'd in a Cobweb.

* *Lib. 6. Obſerv.* 22.

Alexan-

Alexander Benedictus writes also, that at *Venice* a Flock-bed did for many years harbour a pestiferous malignity to that degree, that when afterwards it came to be beaten, it presently infected the by-standers with the Plague.

And the Learned * *Sennertus* himself relates, that in the year 1542. there did in the City of *Uratislavia* (vulgarly *Breslaw*,) where he afterwards practised Physick, dye of the Plague, in less than six Months, little less than six thousand men, and that from that time the Pestilential Contagion was kept folded up in a linnen cloth about fourteen years, and at the end of that time being display'd in another City, it began a Plague there, which infected also the neighbouring Towns and other places.

* Lib. 4. de Feb. cap. 3.

* *Trincavella* makes mention of a yet lastinger Contagion, (which occasion'd the death of ten thousand

* Libr. 3. Con. 17.

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* *Lib.* 4. *de Tab. cap.* 3.

* *Trincavella* makes mention of a yet lastinger Contagion, (which occasion'd the death of ten thousand

* *Libr.* 3. *Con.* 17.

perſons) that lay lurking in certain Ropes, with which at *Juſtinopolis* thoſe that dy'd of the Plague had been let down into their Graves.

But, though none of theſe Relations ſhould to ſome Criticks appear ſcarce credible, it may be objected, that all theſe things, wherein this Contagion reſided, were kept cloſe ſhut up, or at leaſt were not expos'd to the Air. Wherefore having only intimated, that the exception, which I think is not irrational, would, though never ſo true, but *leſſen* the wonder of theſe ſtrange Relations, without rendering them *unfit* for our preſent purpoſe, I ſhall add, that though 'tis the opinion of divers Learned Phyſicians, that the matter harboring Contagion cannot laſt above Twenty or a few more days, if the Body it adheres to be expos'd to the free air and the wind, and though I am not forward to deny, that their judgement may hold in ordinary caſes; yet I muſt not deny neither, that a Contagion may ſometimes

times happen to be much more tenacious and obſtinate: Of which I ſhall give but that one, almoſt recent inſtance, obſerv'd by the Learned *Dimmerbrook* in his own Apothecary, who having but remov'd with his foot, from one ſide to the other of a little Arbour (in his Garden) ſome ſtraw, that had layn under the Pallet, on which near eight Months before a Bed had layn, wherein a Servant of the Apothecaries, that recover'd, had been ſick of the Plague; the infectious ſteams preſently invaded the lower part of his leg, and produc'd a pungent pain and blifter, which turn'd to a peſtilential Carbuncle, that could ſcarce be cur'd in a Fortnight after, though during that time the Patient were neither feaveriſh, nor, as to the reſt of his Body, ill at eaſe. This memorable inſtance, together with ſome others of the like kind, that our Author obſerved in the ſame City (of *Nimmegen*) obtain'd, not to ſay,

* Lib. 4. de Peſte.

extorted, even from him, this Confeſſion; which I add, becauſe it contains ſome conſiderable, and not yet mentioned Circumſtances of the recited caſe: *Hoc exemplo Medicorum Doctrina de Contagio in fomite latente ſatis confirmatur. Mirum tamen eſt, hoc Contagium tanto tempore in prædicto ſtramine potuiſſe ſubſiſtere, utpote quod tota hyeme ventis & pluviis,* (he adds in another place) *nivibus & frigori, expoſitum fuiſſet.*

And now I will ſhut up this Chapter with an inſtance, that ſome will think, perhaps, no leſs ſtrange than any of the reſt, which is, that though they that are skilful in the perfuming of Gloves, are wont to imbue them with but an inconſiderable quantity of odoriferous matter, yet I have by me a pair of *Spaniſh* Gloves, which I had by the favour of your fair and virtuous Siſter (*F.*) that were ſo skilfully perfum'd, that partly by her, partly by thoſe that preſented them her as a Rarity, and partly by me, who have kept them

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ſeveral Years, they have been kept about eight or nine and twenty years, if not thirty, and they are ſo well ſcented, that they may, for ought I know, continue fragrant divers years longer. Which inſtance, if you pleaſe to reflect upon, and conſider, that ſuch Gloves cannot have been carried from one place to another, or ſo much as uncover'd (as they muſt often have been) in the free Air, without diffuſing from themſelves a fragrant Atmoſphere, we cannot but conclude thoſe odorous Steams to be unimaginably ſubtile, that could for ſo long a time iſſue out in ſuch ſwarms; from a little perfum'd matter lodged in the pores of a Glove, and yet leave it richly ſtock'd with particles of the ſame nature; though, (eſpecially by reaſon of ſome removes, in which I took not the Gloves along with me;) I forgot ever ſince I had them, to keep them ſo much as ſhut up in a Box.

OF

Of the

GREAT EFFICACY OF EFFLUVIUMS:

BY

The Honorable *ROBERT BOYLE.*

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CHAP. I.

THey that are wont in the Eſtimates they make of Natural Things, to truſt too much to the negative informations of their Senſes, without ſufficiently conſulting their Reaſon, have commonly but a very little and ſlight opinion of the Power and Efficacy of *Effluviums*; and imagine that ſuch minute Corpuſcles (if they grant that there are ſuch,) as are not, for the moſt part of them, capable to work upon the

tendereſt and quickeſt of Senſes, the Sight, cannot have any conſiderable Operation upon other Bodies. But I take this to be an error, which, *as* it very little becomes Philoſophers, *ſo* it has done no little prejudice to Philoſophy it ſelf, and perhaps to Phyſick too. And therefore though the nature of my deſign at preſent did not *require* it, yet the importance of the ſubject would *invite* me to ſhew, That this is as ill-gounded as prejudicial a Suppoſition.

And indeed if we Conſider the ſubject attentively, we may obſerve, That though it be true, that, *cæteris paribus*, the greatneſs of Bodies doth, in moſt caſes, contribute to that of their Operation upon others, yet Matter or Body being in its own preciſe nature an unactive or moveleſs Subject, one part of the Maſs acts upon another but upon the account of its Local Motion, whoſe Operations are facilitated and otherwiſe diverſified by the Shape, Size, Situation and Texture both of the Agent and of the Patient.

Patient. And therefore if Corpuſcles, though very minute, be numerous enough, and have a competent degree of motion, even theſe ſmall Particles, eſpecially if fitly ſhap'd, when they chance to meet with a Body, which the congruity of its texture diſpoſes to admit them at its Pores, and receive their either friendly or hoſtile impreſſions, may perform ſuch things in the patient, as viſible and much groſſer Bodies, but leſs conveniently ſhap'd and mov'd, would be utterly unable (on the ſame Body) to effect.

And that you may with the leſs difficulty allow me to ſay, that the Effluviums of Bodies, as minute as they are, may perform Conſiderable things, give me leave to obſerve to you, that there are *at leaſt* ſix ways, by which the Effluviums of a Body may notably operate upon another; namely, 1. By the *great number* of emitted Corpuſcles. 2. By their *penetrating* and pervading nature. 3. By their *celerity*, and other Modifications of their Motion. 4. By the *congruity* and *incon-*

gruity of their Bulk and Shape to the Pores of the Bodies they are to act upon. 5. By the *motions* of *one* part *upon another*, that they excite or occaſion in the Body they work upon according to its Structure. And 6*ly*, By the Fitneſs and Power they have to make themſelves be *aſsiſted*, in their Working, by the *more Catholick Agents* of the Univerſe. And though it may perhaps be ſufficiently proved, that there are ſeveral caſes wherein a Body that emits Particles, may act notably upon another Body by this or that ſingle way of thoſe I have been naming; yet uſually the great matters are performed by the aſſociation of two, three or more of them, concurring to produce the ſame Effect. Upon which ſcore when I ſhall in the following Paper referr an Inſtance or a Phenomenon to any one of the forementioned Heads, I deſire to be underſtood as looking upon that but as the Head, to which it *chiefly* relates, without excluding the reſt.

CHAP.

CHAP. II.

TAking thoſe things for granted, that have, I hope, been ſufficiently proved in the former Tract about the ſubtlety of Effluviums, I ſuppoſe it will readily be allowed, That the Emanations of a Body may be extremely minute; whence it may be rightly inferr'd, that a ſmall portion of matter may emit great multitudes of them.

Now that the great number of Agents may in many caſes compenſate their littleneſs, eſpecially where they Act or Reſiſt *per modum unius*, (as they ſpeak,) men would perhaps the more eaſily grant, if they took notice to this purpoſe of ſome familiar Inſtances.

We ſee that not only leſſer Land-floods that overflow the neighbouring Fields, but thoſe terrible Inundations that ſometimes drown whole Countreys, are made by Bodies ſingly ſo ſo ſmall and inconſiderable as Drops

of Rain when they continue to fall in thoſe multitudes we call Showers.

So the aggregates of ſuch minute Bodies as grains of Sand being heaped together in ſufficient Numbers, make Banks wherewith greateſt Ships are ſometimes ſplit, nay and ſerve in moſt places for Bounds to the Sea it ſelf.

And though a ſingle Corn of Gunpowder, or two or three together, are not of Force to do much miſchief, yet two or three Barrels of thoſe Corns taking Fire all together are able to blow up Ships and Houſes, and perform prodigious things.

But inſtead of multiplying ſuch Inſtances, afforded by Bodies of ſmall indeed but yet viſible Bulk, I ſhall (as ſoon as I have intimated, that the above-mentioned drops of Rain themſelves conſiſt of convening Multitudes of Vapors moſt commonly Inviſible in their Aſcent,) endeavour to make out what was propoſed, by two or three Inſtances drawn from the Operations of Inviſible particles.

And firſt, we ſee, that though Aqueous

Aqueous Vapours be look'd upon as the fainteſt and leaſt active Effluviums that we know of, yet when multitudes of them are in Rainy weather diſperſed thorow the Air, and are thereby qualified to work on the Bodies expoſed to it, their Operations are very conſiderable, not only in the diſſolution of Salts, as Sea-Salt, Salt of Tartar, &c. and in the putrefactive changes they produce in many Bodies, but in the intumeſcence they cauſe in Oak and other ſolid Woods; as appears by the difficulty we often find in and before Rainy weather, to ſhut and open Doors, Boxes, and other Wooden pieces of work, that were before fit enough for the Cavities they had been adjuſted to.

I might here urge, that though the ſtrings of Viols and other Muſical Inſtruments are ſometimes ſtrong enough to ſuſtain conſiderable weights, yet if they be left ſcrewed to their full tenſion, (as it frequently happens) they are oftentimes by the ſupervening of moiſt weather made to break, not

without impetuoſity and noiſe. But it may ſute better with my preſent aim, if I mention on this occaſion, (what I elſewhere more fully take notice of:) Being deſirous to try what a multitude even of Aqueous Steams may do, I cauſed a Rope that was long, but not thick, and was in part ſuſtained by a Pully, to have a Weight of Lead ſo faſtned to the end of it, as not to touch the ground, and after the Weight had leiſure allowed it to ſtretch the Cord as far as it could, I obſerved that in the moiſt weather the wateriſh particles, that did inviſibly abound in the Air, did ſo much work upon and ſhorten the Rope, as to make it lift up the hanging Weight, which was, if I mis-remember not, about an hundred Pounds.

The inviſible Steams, iſſuing out of the Walls of a newly plaſter'd or whited Room, are not ſenſibly prejudicial to thoſe that do but tranſiently viſit it, or make but a very ſhort ſtay in it, though there be a Charcoal-fire in the Chimney; but we have many inſtances

inſtances of perſons, that by lying for a night in ſuch Rooms, have been the next morning or ſooner found dead in their Beds, being ſuffocated by the multitude of the noxious Vapours emitted during all that time.

And here I think it proper to obſerve, That it may much aſſiſt us to take notice of the multitude of *Effluvia*, and make us expect great matters from them, to conſider, that they are not emitted from the Body that affords them all at once, as Hail-ſhot out of a Gun, but iſſue from it as the Vaporous Winds do out of an Æolipil well heated, or Waters out of a Spring-head in continued Streams, wherein freſh parts ſtill ſucceed one another; ſo that though as many Effluxions of a Body as can be ſent out at one time were numerous enough to Act but upon its Superficial parts, yet the Emanation of the next minute may get in a little farther, and each ſmalleſt portion of time ſupplying freſh Recruits, and perhaps urging on the Steams already entred, the Particles may

may at length get into a multitude of the pores of the invaded Body, and penetrate it to the very innermoſt parts.

Chap. III.

I Come now to ſhew in the ſecond place, That the ſubtile and penetrating nature of Effluviums, may in many caſes cooperate with their multitude in producing notable effects; and that there are Effluviums of a very piercing nature, though we ſhall not now enquire upon what account they are ſo, we may evince by ſeveral Examples. For not only the inviſible Steams of good *Aqua Fortis* and Spirit of Nitre do uſually in a ſhort time, and in the cold, ſo penetrate the corks wherewith the Glaſſes that contained them were ſtop'd, as to reduce them into a yellow pap; but alſo the emanations of Mercury have been ſometimes found in the

the form of coagulated, or even of running Mercury in the heads or very bones of thoſe Gilders, or Venereal Patients, that have too long or too unadviſedly been expoſed to the fumes of it, though they never took Quick-ſilver in its groſs ſubſtance. Chymiſts too often find in their Laboratories, that the ſteams of Sulphur, Antimony, Arſnick, and divers other Minerals, are able to make thoſe ſtagger, or perhaps ſtrike them down, that without a competent warineſs unlute the Veſſels wherein they had been diſtilled or ſublimed; of which I have known divers ſad Examples. And of the Penetrancy even of animal Steams we may eaſily be perſwaded, if we conſider, how ſoon in many Plagues the contagious, though inviſible, Exhalations are able to reach the Heart, or infect other internal parts; though in divers of theſe caſes the Blood helps to convey the infection, yet ſtill the Morbifick particles muſt get into the body before they can infect the maſs of Blood. And in thoſe ſtupefactions that

are

are cauſed at a diſtance by the *Torpedo*, the parts mainly affected ſeem to be the Nervous ones of the Hand and Arm, which are of the moſt retired and beſt fenced parts of thoſe members. And there is a Spirit of *Sal Armoniack*, that I make to ſmell to, whoſe inviſible Steams, unexcited by heat, are of ſo piercing a nature, that not only they will powerfully affect the Eyes and Noſtrils, and Throats, and ſometimes the Stomachs too (yet without proving Vomitive,) of the Patients they invade, but alſo when a great cold has ſo clog'd the organs of ſmelling, that neither ſweet nor ſtinking odours would at all affect them, theſe piercing Steams have not only in a few minutes both made themſelves a way, and which is more, ſo open'd the paſſages, that ſoon after the Patient has been able to ſmell other things alſo. And by the ſame penetrating Spirit, a perſon of Quality was, ſome time ſince, reſtored to a power of ſmelling, which he had loſt for divers Years, (if he ever had it equally with other men.) I could

eaſily

eaſily ſubjoyn Examples of this kind, but they belong to other places. And here I ſhall only add, that the ſteams of Water it ſelf aſſiſted by warmth, are capable of diſſolving the Texture of even hard and ſolid bodies, that are not ſuſpected to be Saline, as appears by the Philoſophical calcination (as Chymiſts call it) wherein ſolid pieces of Harts-horn are brought to be eaſily friable into pouder, by being hung over waters, whil'ſt their ſteams riſe in diſtillation and without the help of Furnaces. The Exhalations, that uſually ſwim every night in the air, and almoſt every night fall to the ground in the form of Dews (which makes them be judged Aqueous,) are in many places of the Torrid Zone of ſo penetrating a nature, that, as Eye-witneſſes have informed me, they would in a very ſhort time make Knives ruſt in their ſheaths, and Swords in their ſcabbards, nay and Watches in their caſes, if they did not conſtantly carry them in their pockets. And I have known even in *England* divers

divers hard bodies, into which the Vapours ſwimming in the air have inſinuated themſelves, ſo far as to make them friable throughout. But of the penetration of Effluviums, I have given, in ſeveral places, ſo many inſtances, that 'tis not neceſſary to add any here. And therefore to ſhew, that, as I intimated at the beginning of this Chapter, the Penetrancy and the multitude of Effluviums may much aſſiſt each other, I ſhall now ſubjoyn; That we muſt not for the moſt part look upon Effluviums as ſwarms of Corpuſcles, that only beat againſt the outſides of the Bodies they invade, but as Corpuſcles, which by reaſon of their great and frequently recruited numbers, and by the Extreme ſmallneſs of their Parts, inſinuate themſelves in multitudes into the minute pores of the bodies they invade, and often penetrate to the innermoſt of them; ſo that, though each ſingle Corpuſcle, and its diſtinct action, be inconſiderable, in reſpect of the multitude of parts that compoſe

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the body to be wrought on; yet a vaſt multitude of theſe little Agents working together upon a correſpondent number of the ſmall parts of the body they pervade, they may well be able to have powerful effects upon the Body, that thoſe parts conſtitute; as, in the caſe mentioned in the former Chapter, the Rope would not probably have been enabled to raiſe ſo great a weight, though a vehement Wind had blown againſt it, to make it loſe its perpendicular ſtraightneſs, but a vaſt multitude of Watery Particles, getting by degrees into the pores of the Rope, might, like an innumerable company of little wedges, ſo widen the pores as to make the thrids or ſplinters of Hemp, the Rope was made up of, ſwell, and that ſo forcibly, that the depending weight could not hinder the ſhortning of the Rope, and therefore muſt of neceſſity be rais'd thereby. And I have more than once known ſolid and even heavy Mineral Bodies, burſt in pieces by the moiſture of the Air, though

we

we kept them within-doors carefully ſhelter'd from the Rain.

CHAP. IV.

THat the *Celerity* of the motion of very minute Bodies, eſpecially conjoyned to their multitudes, may perform very notable things, may be argued from the wonderful effects of fired Gunpowder, *Aurum fulminans*, of Flames that inviſibly touch the Bodies they work on, and alſo Whirlwinds, and thoſe ſtreams of inviſible Exhalations and other aerial Particles we call Winds. But becauſe inſtances of this ſort ſuit not ſo well with the main ſcope of this Tract, I ſhall not inſiſt on them, but ſubjoyn ſome others, which, though leſs notable in themſelves, will be more congruous to my preſent Deſign. That the Corpuſcles whereof Odours conſiſt, ſwim to and fro in the Air, as in a fluid Vehicle, will by

by moſt, I preſume, be granted, and may be eaſily prov'd. But I have elſewhere ſhewn, That the motion of the Effluviums of ſome ſufficiently odorous Bodies, has too little Celerity to make a ſenſible impreſſion on the organs of ſmelling, unleſs thoſe Steams be aſſiſted to beat more forcibly upon the Noſtrils by the Air, which hurries them along with it, when it enters the Noſtrils in the form of a ſtream, in the act of Inſpiration. And I have by familiar obſervation of Hunters, Fowlers, and partly of my own made manifeſt, that Setting-dogs, Hounds, Crows and ſome other animals, will be much more affected with ſents, or the odorous *Effluvia* of Partridges, Hares, Gunpowder, *&c.* when the Wind blows from the object towards the ſenſory, than when it ſits the contrary way, which way ſoever the Noſtrils of the animal be obverted, ſo the Air be imbued with the odorous Steams: And conſequently the difference ſeems to proceed from this, that when the Noſtrils are obverted

to the Wind, the Current of the Air drives the Steams forcibly upon the Senſory, which otherwiſe it does not.

That there is a briskneſs of motion requiſite, and more than ordinarily conducive to *Electrical* attractions, may be argued from the neceſſity that we uſually find by rubbing Amber, Jett, and other Electrical bodies, to make them emit thoſe Steams, by which 'tis highly probable their action is performed: And though I have elſewhere ſhewn, that this precedent rubbing is not alwayes neceſſary to excite all Electrical bodies; yet in thoſe that I made to attract without it, it would operate much more vigorouſly after attrition; which I conceive makes a reciprocal motion amongſt the more ſtable parts, and does thereby as 'twere diſcharge and ſhoot out the attracting Corpuſcles; whoſe real emiſſion, though it may be probably argued from what has been already ſaid, ſeems more ſtrongly proveable by an Obſervation that

I made

I made many years ago, and which I have been lately inform'd to have been long ſince made by the very Learned *Fabri*. The Obſervation was this; That if, when we took a vigorouſly excited Electrick, we did at a certain nick of time (which circumſtances may much vary, but was uſually almoſt as ſoon as the body was well rubbed) place it at a juſt diſtance from a ſuſpended Hair or other light body, or perhaps from ſome light powder; the Hair, *&c.* would not be attracted to the Electrick, but driven away from it, as it ſeem'd, by the briskly moving ſteams that iſſue out of the Amber or other light body.

This Argument I could confirm by another Phænomenon or two of affinity with this, if I ſhould not borrow too much of what I have elſewhere noted about the Hiſtory of *Electricity*.

I know a certain ſubſtance, which though made by diſtillation, does in the cold emit but a very mild and inoffenſive ſmell, but when the veſſel

that holds it is heated, though no ſeparation of conſtituent Principles appear to be thereby made, (the Body being in all uſual tryals homogeneous,) the Effluviums will be ſo altered, that I remember a Virtuoſo, that, to ſatisfie his curioſity, would needs be ſmelling to it, when 'twas heated, complain'd to me, that he thought the Steams would have killed him, and that the Effluviums of Spirit of *Sal Armoniack* it ſelf were nothing near ſo ſtrong and piercing as thoſe.

And even among ſolid Bodies, I know ſome, which, though abounding much in a ſubſtance wherein ſome rank ſmells principally reſide, yet (if they were not chafed) were ſcarce at all ſenſibly odorous; but upon the rubbing of them a little one againſt the other, the attrition making them, as it were, dart out their Emiſſions, would in a minute or two make them ſtink egregiouſly.

And as the Celerity of motion may thus give a vigor to the Emanations of Bodies, ſo there may be other

other modifications of motion, that may contribute to the ſame thing, and are not to be wholly neglected in this place. For as we ſee, that greater Bodies do operate differingly according to ſuch and ſuch modifications; as there is a great difference between the effects of a Dart or Javelin, ſo thrown as that its point be alwayes forwards, and the ſame weapon if it be ſo thrown, that during its progreſſive motion the extremes turn about the Center of gravity or ſome inward parts, as it happens when Boyes throw ſticks to beat down fruit from the tops of trees; ſo there is little doubt to be made, but that in Corpuſcles themſelves 'tis not all one, as to their effects, whether they move with or without rotation, and whether in ſuch or ſuch a line, and whether with or without undulation, trembling or ſuch a kind of conſecution; and in ſhort, whether the motion have or have not this or that particular modification; which how much it may diverſifie the Effects

of the Bodies moved, may appear by the Motion, that the Aerial particles are put into by Muſical Inſtruments. For, though the effects of harmony, diſcord and peculiar ſounds be ſometimes very great, not only in Human bodies, but, as we ſhall ſhew in the following Tract, in Organical ones too; the whole efficacy of Muſick and of Sounds that are not extraordinarily loud and different, ſeems, as far as 'tis aſcribable to Sonorous bodies, to depend upon the different manners of motion whereinto that Air is put, that makes the immediate impreſſion on our organs of hearing.

Chap. V.

I Should now proceed to ſhew, how the *Celerity* and other modes, that diverſifie the motion of Effluviums, may be aſſiſted to make them operative by their determinate ſizes and figures, and

and the congruity or incongruity which they may have upon that ſcore with the Pores of the groſſer Bodies they are to work on: But I think it not fit to entrench upon the ſubject of another * Tract, where the relation between the figures of Corpuſcles and the Pores of groſſer bodies is amply enough treated of. And therefore I ſhall only in this place take notice of thoſe effects of Lightning, which ſeem referable, partly to the Celerity and manner of Appulſe, and partly to the diſtinct ſizes and ſhapes of the Corpuſcles that compoſe the deſtructive matter, and to the peculiar relation between the particles of that matter and the ſtructure of the bodies they invade. I know that many ſtrange things that are delivered about the Effects of what the Latins call *Fulmen* (which our Engliſh word *Lightning* does not adæquately render) are but fabulous; but there are but too many that are not ſo; ſome of which I have been

* *Of the Pores of Bodies, and Figures of Corpuſcles.*

an Eye-witneſs of, within leſs than a quarter of an hour after that the things happened. And though it be very difficult to explicate particularly many of theſe true Phenomena, yet it ſeems warrantable enough to argue from them, that there may be Agents ſo qualified, and ſo ſwiftly moved, that notwithſtanding their being ſo exceedingly minute, as they muſt be, to make up a flame, which is a fluid Body, they muſt in an imperceptible time pervade ſolid Bodies, and traverſing ſome of them without violating their Texture, burn, break, melt, and produce other very great changes in other Bodies that are fitted to be wrought on by them. And of this I muſt not forget to mention this remarkable inſtance; That a perſon Curious enough to collect many rarities, bringing me one day into the Study where he kept the choiceſt of them, I ſaw there among other things a fine pair of Drinking-glaſſes that were ſomewhat ſlender, but extraordinarily tall; they ſeem'd to have been

been deſigned to reſemble one another, and made for ſome drinking entertainment. But before I ſaw them, that reſemblance was much leſſen'd by the Lightning, that fell between them in ſo ſtrange a manner; that, without breaking either of them, that I could perceive, it alter'd a little the figure of one of them, near the lower part of the Cavity; but the other was ſo bent near the ſame place as to make it ſtand quite awry, and give it a poſture, that I beheld not without ſome amazement. And I cannot yet but look upon it as a very ſtrange thing, and no leſs conſiderable to our preſent purpoſe, that Nature ſhould in the free Air make of Exhalations, and that ſuch as probably when they aſcended were inviſible, ſuch an aggregate of Corpuſcles, as ſhould without breaking ſuch frail Bodies as Glaſſes, be able in its paſſage thorow them, that is, in the twinkling of an Eye, to melt them; which to do is wont even in our Reverberatory Furnaces to coſt the

the active flames a pretty deal of time.

And this calls into my memory, that upon a time, hearing not far off from me ſuch a clap of Thunder as made me judge and ſay, that queſtionleſs ſome of the neighbouring places were thunder-ſtrook, I ſent preſently to make inquiry; which having juſtified my conjecture, I forthwith repaired to the houſe, where the miſchief was done, by ſomething, which thoſe, that pretended to have ſeen it coming thither, affirm'd to be like a flame moved very obliquely. To omit the hurt, that ſeemed to have been done by a Wind that accompanied it, or was perhaps produced by it, to divers perſons and cattel; that which makes me here mention it, was, that obſerving narrowly what had happen'd in an upper room, where it firſt fell, I ſaw, that it had in more than one place melted the Lead in its paſſage, (though that poſſibly outlaſted not the twinkling of an Eye,) without breaking to

pieces

pieces the glaſs-caſements, or burning (that I took notice of) either the Bed or Hangings or any other combuſtible houſhold-ſtuff; though near the window it had thrown down a good quantity of the ſolid ſubſtance of the Wall, through which it ſeem'd to have made its paſſage in or out. And that, which made me the leſs ſcruple to mention this accident, is, that having curiouſly pry'd into the Effects of the *Fulmen*, not only in that little upper room, but in other parts of the Houſe, beneath whoſe lowermoſt parts it ſeem'd to have ended its extravagant courſe, I could not but conclude, That if ſo be it were the ſame *Fulmen*, it muſt have more than once gone in and out of the Houſe, and that the line of its motion was neither ſtraight, nor yet reducible to any curve or mixed line, that I had met with among Mathematicians; but that, as I then told ſome of my Friends, it moved to and fro in an extravagant manner, not unlike the irregular and wrigling motion of

thoſe

those fired Squibs that Boys are wont to make by ramming Gunpowder into Quills. But about Thunder more perhaps elsewhere. I shall here only add, That whereas 'tis a known Tradition, which my own Observations heedfully made seem now and then to confirm, that vehement Thunder, if Beer be not very strong, will usually (for I do not say alwayes) sowre it in a day or two; if this degeneration be not one of the consequences of the great and peculiar kinds of the concussions of the Air that happens in lowd Thunder (in which case the Phenomenon will belong to the next Discourse,) the effect may probably be imputed to some subtile Exhalations diffused thorow the Air, which, penetrating the pores of the Wooden vessels, whose contexture is not very close, imbue the liquor with a kind of acetous Ferment; which conjecture I should think much confirmed by a tryal, it suggested to me, if I had made it often enough to rely upon it. For considering that the pores

pores of Glaſs are ſtraight enough to be impervious (for ought I have yet obſerved) to the Steams or ſpirituous parts of Sulphur as well as to other odorous Exhalations, I thought it worth trying, whether there be any ſulphureous Steams or other Corpuſcles diffuſed thorow the Air in time of Thunder, that would not be too groſs to get in at ſuch minute pores as thoſe of Glaſs. And accordingly having Hermetically ſealed up both Beer and Ale apart, I kept them in Summer time till there happen'd a great Thunder, a day or two, after which the Beer which we drank, that was good before, being generally complained of as ſowred by the Thunder, I ſuffer'd my liquors to continue at leaſt a day or two longer, that the ſowring Steams, if any ſuch there were, might have time enough to operate upon them, and then breaking the Glaſſes, I found not that the liquors had been ſowred, though we had purpoſely forborn to fill the Glaſſes, to facilitate the degeneration of

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the liquors. Perhaps it will be pardonable on this occasion to mention a practice, which is usual in some places where I have been, and particularly employ'd by a great Lady, that is a great house-keeper, and is very curious and expert in divers Physical Observations; for, talking with her about the remedies of the Sowring of Beer and other drinks by Thunder, which is sometimes no small prejudice to her, she affirm'd to me, that she usually found the practice, I was mentioning, succeed: And that before the then last great Thunder, of which I had observed the Effects upon Beer, she preserved hers by putting, at a convenient distance, under the Barrels, Chaffing-dishes of Coals, when she perceiv'd that the Thunder was like to begin, which practice, if it constantly succeed, may put one a considering, whether the Fire do not by rarifying the Air and discussing the sulphureous or other Steams, by altering them, or by uniting with them the Exhalations

of

of the Coals, or by ſome ſuch kind of way, render ineffectual theſe ſowring Corpuſcles, which perhaps require a determinate bulk and ſhape, beſides their being crowded very many of them together, to have their full Operation on Barrell'd Liquors. But theſe things are but meer Conjectures, and therefore I proceed.

CHAP. VI.

THE fifth way whereby Effluviums may perform notable things, is the Motion of one part upon another, that they may excite or occaſion in the Body they work on according to its ſtructure.

I ſhall in the following Tract have occaſion to ſay ſomething of the Motions into which the Internal parts of Inanimate Bodies may put one another; but the Examples now produced are deſigned to manifeſt the Efficacy, that Effluviums may, on the newly

newly mentioned accounts, have on Organical and living Bodies. To which Inſtances it would yet be proper to premiſe, That even Inanimate and Solid Bodies may be of ſuch a ſtructure as to be very much alterable by the appropriated Effluviums of other Bodies, as may be inſtanc'd in the power, that I have known ſome vigorous Loadſtones to have, of taking away in a trice the attractive virtue of an excited Needle, or giving a verticity directly contrary to the former without ſo much as touching it.

And we may pertinently take notice of the attractive virtue of the Loadſtone, as that, which may afford us an eminent Example of the great power of a multitude of inviſible Effluviums, even from Bodies that are not great, upon Bodies that are Inorganical or liveleſs: For taking it for granted, what both the *Epicureans*, *Carteſians*, and almoſt all other Corpuſcularian Philoſophers agree in, that Magnetiſm is performed by corporeal Emiſſions, we may conſider, that

that theſe paſſing unreſiſtedly thorow the pores of all ſolid Bodies, and even Glaſs it ſelf, which neither the ſubtileſt Odours nor Electrical Exhalations are obſerv'd to do, ſeem to be almoſt incredibly minute, and much ſmaller than any other Effluviums, though themſelves too ſmall to be viſible; and yet theſe ſo incomparably little Magnetical Effluxions proceeding from vigorous Loadſtones, will be able to take up conſiderable quantities of ſo ponderous a Body as Iron; in ſo much that I have ſeen a Loadſtone not very great, that would keep ſuſpended a weight of Iron, that I could hardly lift up to it with one Arm; and I have ſeen a little one, with which I could take up above eighty times its weight. And theſe *Effluvia* do not only for a moment faſten the Iron to the Stone, but keep the Metal ſuſpended as long as one pleaſes.

This being premiſed, I come now to obſerve, That the chief effects of *Effluvia* belonging to the fifth Head

are wrought upon Animals, which by virtue of their curious and elaborate ſtructure, have their parts ſo connected and otherwiſe contrived, that the motions or changes that are produced in one, may have by the conſent of Parts a manifeſt operation upon others, although perhaps very diſtant from it, and ſo fram'd as to declare their being affected by actions that ſeem to have no affinity at all with the Agents that work upon the part firſt affected.

I have ſhewn at large in another * Treatiſe, that a Humane Body ought not to be look'd upon meerly as an aggregate of Bones, Fleſh, and other conſiſtent parts, but as a moſt curious and a living Engin, ſome of whoſe parts, though ſo nicely fram'd as to be very eaſily affected by external Agents, are yet capable of having great Operations upon the other parts of the Body, they help to compoſe. Wherefore without now repeating what is there already deliver'd,

* *The Uſefulneſs of Experimental Philoſophy.*

liver'd, I ſhall proceed to deliver ſuch Effects as are wrought on Human Bodies by theſe Effluviums without any immediate contact of the Bodies that emit them.

And firſt, not to mention *Light*, becauſe its being or not being a Corporeal thing is much diſputed even among the Moderns; 'tis plain, that our organs of Smelling are ſenſibly affected by ſuch minute Particles of matter as the fineſt odours conſiſt of. Nor do they alwayes affect us preciſely as odours, ſince we ſee, that many perſons, both men and women, are by Smells, either ſweet or ſtinking, put into troubleſom Headaches.

If it were not almoſt ordinary, it would be more than almoſt incredible, that the ſmell of a pleaſing Perfume ſhould preſently produce in a Human Body, that immediately before was well and ſtrong, ſuch faintneſſes, ſwoons, loſs of ſenſible reſpiration, intumeſcence of the *Abdomen*, ſeeming Epilepſies, and really convulſive motions of the Limbs, and

I know not how many other frightful Symptoms, that by the unskilful are often taken for the effects of Witchcraft, and would impoſe upon Phyſicians themſelves, if their own or their Predeceſſors Experience did not furniſh them with Examples of the like *Phænomena* produc'd by Natural means. Thoſe Symptoms manifeſt, what the conſent of Parts may do in a Humane Body; ſince even Morbifick Odours, if I may ſo call them, by immediately affecting the organs of Smelling, affect ſo many other parts of the *genus Nervoſum*, as oftentimes to produce Convulſive motions, even in the extreme parts of the Hands and Feet.

Nor is the efficacy of Effluviums confined to produce Hyſterical fits, ſince theſe inviſible Particles may be able (and ſometimes as ſuddenly as Perfumes are wont to excite them) to appeaſe them, as I have very frequently, though not with never-failing ſucceſs, tryed, by holding a Spirit, I uſually make of *Sal Armoniack*,

niack, under the Noſtrils of Hyſterical perſons. My remedy did not only often recover, in a trice, thoſe whoſe Fits were but ordinary, but did more than once, ſomewhat to the wonder of the By-ſtanders, relieve, within a Minute or two, perſons of differing Ages and Conſtitutions, that were ſuddenly fallen down by Fits, that the By-ſtanders judg'd *Epileptical*, (but I, *Hyſterical.*)

I attribute the good and evil Operations of the fore-mentioned Steams, rather in general to the conſent of the parts that make up the *genus Nervoſum*, than to any hidden Sympathy or Antipathy betwixt them and the Womb, not only for other reaſons, not proper to be inſiſted on here, but becauſe I have known Odours have notable Effects even upon Men. I know a very eminent perſon, a Traveller, and a man of a ſtrong conſtitution, but conſiderably Sanguine, who is put into violent Head-aches by the Smell of Musk. And I remember, that one day being

with him and a great many other men of note about a Publick Affair, a man that had a parcel of Musk about him, having an occasion to make an application to us, this person was so disordered by the smell, which to most of us was delightful, that in spight of his Civility he was reduc'd to make us an Apology, and send the perfumed man out of the room, notwithstanding whose recess this person complained to me, a good while after, of a violent pain in his Head, which I perceived had somewhat unfitted him for the Transaction of the Affair whereof he was to be the chief manager. I know another person, whose happy Muse hath justly made him many Admirers, that is subject to the Head-ach upon so mild a smell as that of Damask-Roses, and sometimes even of Red-Roses, in so much that walking one day with him in a Garden, whose Alleys were very large, so that he might easily keep himself at a distance from the Bushes, which bore many of them Red-Roses, he

he abruptly broke off the discourse we were engag'd in, to complain of the harm the Perfume did his Head, and desired me to pass into a Walk, that had no Roses growing near it.

If it were not for the Sex of this person, I could relate an Instance that would be much more considerable of the Operation of Roses. For I know a discreet Lady to whom their smell is not *unpleasing*, (for she answer'd me that 'twas not so at all,) but so *hurtful*, that it presently makes her sick, and would make her swoon if not seasonably prevented: And she told me that being once at a Court in which she was a Maid of Honour, though she her-self did not know whence it came, she found her self extremely ill on a sudden, and ready to sink down for faintness; but being then in discourse with a person, whose High Quality she payd her profound respect to, her Civility, that kept her from complaining or withdrawing, might have been dangerous if not fatal to her, had not the Princess

who was ſpeaking with her, and who knew her Antipathy to Roſes, taken notice that her Face grew ſtrangely pale, and was covered with a cold ſweat. For thereby preſently gueſſing what might be the cauſe, which the ſick Lady her ſelf did not, ſhe asked aloud whether ſome body had not brought Roſes (which were then in ſeaſon) into the Bed-chamber, which queſtion occaſioned a ſpeedy withdrawing of a Lady, that ſtood at a diſtance off, and had about her Roſes, which were not ſeen by the Patient, who was by this means preſerved from falling into a ſwoon, though not from being for a while very much diſcompoſed.

But this you may tell me was the caſe of a *Woman*, who complain'd her malady affected her Heart, not her Head. Wherefore returning to what I was ſpeaking of before I mention'd Her, I ſhall proceed to tell you, that as Odours may thus give Men the Head-ach, ſo I have often found the ſmell of rectified Spirit of *Sal Armoniack*

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to free Men as well as Women from the Fits of that diſtemper; and that ſometimes in ſo few Minutes, that the perſons reliev'd could ſcarcely imagine, they could ſo quickly be ſo.

To which I ſhall not add the Tryals that I have ſucceſsfully made upon my ſelf, becauſe being, thanks be to God, very ſeldom troubled with that diſtemper, the occaſions I have had of making them have not been many. And though I have not *always* found ſo ſlight a Remedy to work the deſired Cure, yet that it does it often, even in Men, is ſufficient to ſhew the Efficacy of Sanative Effluviums.

Now, to manifeſt, that Steams do not Operate only upon Hyſterical Women, or perſons ſubject to the Head-ach, I will add ſome Inſtances of the Effects they may produce upon other perſons, and parts.

'Tis but too well known an Obſervation, that Women with Child have been often made to miſcarry by the ſtink of an ill-extinguiſht Candle, though

though perhaps the ſmoak aſcending from the Snuff were diſſipated into the inviſible Corpuſcles, a good while before it arriv'd at the Noſtrils of the unhappy Woman; and what violent and ſtraining motions Abortions are frequently accompanied with, is ſufficiently known already.

I think I have elſewhere mentioned, that a Gentleman of my acquaintance, a proper and luſty man, will be put into the fits of Vomiting by the ſmell of Coffee, boyl'd in Water; I ſhall therefore rather mention, that I know a Phyſician, who having been, for a long time when he was young, frequently compelled to take *Electuarium lenitivum*, one of the gentleſt and leaſt unpleaſant Laxatives of the Shops, conceived ſuch a diſlike of it, that ſtill, as himſelf has complained to me, if he ſmell to it, as he ſometimes happens to do in Apothecaries Shops, it will work (now and then for ſeveral times) upwards and downwards with him.

I know another very ingenious perſon

perſon of the ſame faculty, that has been a Traveller by Sea and Land, who has complain'd to me, that the ſmell of the Greaſe of the Wheels of a Hackney-coach, though it do but paſs by him, is wont to make him ſick and ready to Vomit.

Every body knows, that Smoak is apt to make mens Eyes water, and excite in the organs of Reſpiration that troubleſom and vehement commotion we call Coughing. But we need not have recourſe at all to viſible Fumes, for the production of the like Effects; ſince we have often obſerved them, and repeated Sneezings to boot, to proceed from the inviſible Steams of Spirit of *Sal Armoniack*, when Vials containing that liquor, though they were perhaps but very ſmall, were approached too haſtily, or perhaps too near to the Noſtrils.

And becauſe in moſt of the foregoing Inſtances, the chief Effects ſeem to be wrought, by the conſent of parts, on the *genus Nervoſum* and the action of one of them upon the other,

other, and thereby upon ſeveral other parts of the Body, I will ſubjoyn a remarkable inſtance of the Operation of a mild and grateful Odour upon the Humors themſelves, and that in a Man.

A famous Apothecary, who is a very tall and big man, ſeveral times told me, that though he was once a great lover of Roſes, yet having had occaſion to employ great quantities of them at a time, he was ſo altered by their Steams, that now, if he come among the Roſe-buſhes, the ſmell does much diſcompoſe him. And the odour of Roſes, (I mean Incarnate-Roſes, which we commonly call Damask-Roſes, though they be not the true ones,) makes ſuch a colliquation of Humors in his Head, that it ſets him a coughing, and makes him run at the Noſe, and gives him a ſore throat; and by an affluence of Humors makes his Eyes ſore, in ſo much that during the ſeaſon of Roſes, when quantities of them are brought into his Houſe, he is oblig'd

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for the moſt part to abſent himſelf from home.

CHAP. VII.

ONE may ſhew on this occaſion, that as there might be conſiderable things performed by Effluviums, as they make one part of a living Engine work upon another by virtue of its ſtructure, ſo the action of ſuch inviſible Agents may in divers caſes be much promoted by the fabrick and laws of the Univerſe it ſelf, upon this account, that, by the Operation of *Effluvia* upon particular Bodies, they may diſpoſe and qualifie thoſe Bodies to be wrought upon, which before they were not fit to be, by Light, Magnetiſms, the Atmoſphere, Gravity or ſome other of the more Catholick Agents of Nature, as the World is now conſtituted. But not to injure another Tract, I ſhall conclude this, when I ſhall have taken notice,

notice, that in the Instances hitherto produced, there has been a visible Local distance between the Body that emits Steams, and that on which they work. But if I thought it necessary, it were not difficult to shew, that one might well enough referr to the title of this Tract divers Effects of Bodies that are applied immediately to ours; such as are Blood-stones, Cornelions, Nephritick-stones, *Lapis Malaccensis*, and some Amulets, and other solid substances applied by Physicians outwardly to our Bodies. For in these applications the gross Body touches but the Skin, and the great Effects, which I elsewhere relate my self to have sometimes (though not often, much less alwayes) observed to have followed upon this External contact or near application, may reasonably be derived from the subtle Emanations, that pass thorow the Pores of the Skin to the inward parts of the Body: As is evident in those, who by holding *Cantharides* in their Hands, or having them apply'd

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to ſome remote External part, have grievous pains produc'd in their Urinary parts, as it has happen'd to Me as well as to many others. And to the inſinuation of theſe minute Corpuſcles, that get in at the Pores of the Skin, ſeems to be due the Efficacy of ſome Medicines, that purge, vomit, reſolve the Humors, or otherwiſe notably alter the Body being but externally applied; of which I could here give ſeveral Inſtances, but that they belong more properly to another place, and are not neceſſary in this, where it may ſuffice to name the notorious Power, that Mercurial Oyntments or Fumes, either together or apart, have of producing Copious Salivations, to ſhew in general, that both the Steams and the Emanations of outwardly applied Medicinal Bodies may have ſome great Effects on Human ones.

OF THE
Determinate Nature
OF
EFFLUVIUMS.

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OF THE DETERMINATE NATURE OF *EFFLUVIUMS.*

CHAP. I.

THE Effluviums of Bodies, *Pyrophilus*, being for the moſt part inviſible, have been wont to be ſo little conſider'd by vulgar Philoſophers, that ſcarce vouchſafing to take notice of their Exiſtence, 'tis no wonder that men have not been ſolicitous to diſcover their diſtinct Natures and Differences. Only * *Ariſtotle*, and (upon his account) the Schools, have been pleaſed to think,

* *Lib. 1. Meteor. cap. 3, & 4.*

think, that the two grand parts of our Globe do sometimes emit two kinds of Exhalations or Steams; the *Earthy* part affording those that are hot and dry, which they name *Fumes*, and very often, simply, *Exhalations*; and the *Aqueous* part, others that are (not as many of his Disciples mistake him to have taught, Cold and Moist, but) Hot and Moist *, which they usually call *Vapours*, to discriminate them from the Fumes (or Exhalations,) though otherwise, in common acceptation, those Appellations are very frequently confounded.

* Cap. 3. Ἐστι γὰρ ἀτμίδος μὲν ἐύσις, ὑγρὸν καὶ θερμόν.

But, though the *Aristotelians* have thus perfunctorily handled this Subject, it would not become Corpuscularian Philosophers, who attribute so much as they do to the Insensible Particles of Matter, to acquiesce in so slight and jejune an account of the Emanations of Bodies. And since we have already shewn, that besides the greater and more simple Masses of

of Terreſtrial and Aqueous matter newly mention'd, there are very many mixt Bodies, that emit Effluviums, which make, as it were, little Atmoſpheres about divers of them, it will be congruous to our Doctrine and Deſign, to add in this place, That beſides the ſlight and obvious differences, taken notice of by *Ariſtotle*, the Steams of Bodies may be almoſt as various as the Bodies themſelves that emit them, and that therefore we ought not to look upon them barely under the general and confuſed notion of Smoak or Vapours, but may probably conceive them to have their diſtinct and determinate Natures, oftentimes (though not always) ſuitable to that of the Bodies from whence they proceed.

And indeed the newly mentioned Diviſion of the *Schools* gives us ſo ſlight an account of the Emanations of Bodies, that, methinks, it looks like ſuch another, as if one ſhould divide Animals into thoſe that are *Horned*, and thoſe that have *Two Feet*;

For, beſides that the Diſtinction is taken from a Difference that is not the conſiderableſt, there are divers Animals (as many four-footed Beaſts and Fiſhes) that are not compriſed in it, and each member of the Diviſion comprehends I know not how many diſtinct ſorts of Animals, whoſe differences from one another are many times more conſiderable, than thoſe that conſtitute the two ſupreme *Genus's*, the one having Bulls and Goats, and Rhinoceros's, and Deer, and Elks, and certain Sea-Monſters whoſe Horns I have ſeen; and the other *Genus* compriſing alſo a greater Variety, namely, a great part of Four-footed Beaſts, and, beſides Men, all the Birds (for ought we know) whether of Land or Water. And as it would give us but a very ſlender Information of the Nature of an Elk or an Unicorn, to know that 'tis an *Horned* Beaſt; or of the Nature of a Man, an Eagle, or a Nightingale, to be told, that 'tis an *Horn-leſs* Beaſt; ſo it will but very little inſtruct a man

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in the Nature of the Steams of *Quick-silver* or of *Opium*, to be told, that they are Vapours Hot (or rather Cold) and Moist; or of the Steams of *Amber* or *Cantharides*, or *Cinnamon*, or *Tobacco*, to be told, that they are Hot and Dry. For, besides that there may be Effluviums, which, even by their Elementary Qualities, are not of either of these two supreme *Genus's*, (for they may be Cold and Dry, or Cold and Moist,) these Qualities are often far from being the Noblest, and consequently those that deserve to be most consider'd in the Effluviums of this, or that, Body; as we shall by and by have occasion to manifest.

CHAP. II.

AND here it may not be improper to mention an Experiment, that, I remember, I divers years since

employed to illustrate the Subject of our present Discourse.

I consider'd then, that Fluid Bodies may be of very unequal density and gravity, as is evident in Quick-silver, Water and pure Spirit of Wine; which, notwithstanding their great difference in specifick gravity, may yet agree in the conditions requisite to Fluid Bodies. Therefore presuming, that by what I could make appear visible in one, what happens analogically in the other, may be ocularly illustrated, I took some Ounces of Roch-allom, and as much of fine Salt-peter. I took *some Ounces* of each, because, if the quantity of the ingredients be too small, the concoagulated grains will be so too, and the success will not be so conspicuous. These being dissolved together in fair Water, the filtrated solution was set to evaporate in an open-mouthed Glass, and being then left to shoot in a cool place, there were fastned to the sides and other parts of the Glass several small Crystals, some Octoedrical, which

which is the figure proper to Roch-allom, and others of the Prismatical shape of pure Salt-peter; besides some other Saline concretions, whose being distinctly of neither of these two shapes, argued them to be concoagulations of both the Salts. And this we did by using such a degree of Celerity in Evaporating the liquor, as was proper for such an effect. For, by another degree, which is to be employ'd when one would recover the Salts more distinctly and manifestly, the matter may (as I found by tryal) be so ordered, that the aluminous Salt may, for the most part, be first coagulated by it self, and then from the remaining liquor curiously shap'd Crystals of Nitre may be copiously obtained.

Tryals like this we also made with other Salts, and particularly with Sea-Salt, and with Allom and Vitriol; the *Phænomena* of which you may meet with in their due places. For the recited Experiment may, I hope, alone serve to assist the imagination

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to conceive, how the Particles of Bodies may ſwim to and fro in a Fluid, (which the Air is,) and though they be little enough to be inviſible, may many of them retain their diſtinct and determinate natures, and their aptneſs to cohere upon occaſion; and others may, by their various occurſions and coalitions, unite into leſſer Corpuſcles or greater Bodies differing from the more ſimple Particles, that compoſed them, and yet not of indeterminate though compounded Figures.

Chap. III.

THeſe things being premis'd, we may now proceed to the particular Inſtances of the Determinate Nature of Effluviums; and theſe we may not inconveniently reduce to the three following Heads, to each of which we ſhall aſſign a diſtinct Chapter; the firſt of theſe I ſhall briefly

briefly treat of in this third Chapter, and treat somewhat more largely of the others in the two following.

In the first place then, That the Effluviums of many Bodies retain a determinate Nature oftentimes in an invisible smallness, and oftener in such a size as makes them little enough to fly or swim in the Air; may appear by this, that these *Effluvia* being by Condensation or otherwise reunited, they appear to be of the same nature with the Body that emitted them. Thus in moist weather, the Vapours of Water, that wander invisibly through the Air, meeting with Marble-Walls or Pavements, or other Bodies, by their Coldness and other Qualifications, fit to condense and retain them, appear again in the form of Drops of Water; and the same Vapours return to the visible form of Water, when they fall out of the Air in Dews, or Rains.

Quicksilver it self, if it be made to ascend in distillation with a convenient degree of Fire, will almost all be

be found again in the Receiver in the form of running Mercury. Which ſtrange and piercing Fluid, is in ſome caſes ſo diſpoſed to be ſtrip'd of its Diſguiſes, and re-appear in its own form, that divers Artificers, and eſpecially Gilders, have found, to their coſt, that the fumes of it need not be, as in Diſtillation, included in cloſe Veſſels to return to their priſtine nature, Mercury having been ſeveral times found in the Heads and other parts of ſuch People, who have in tract of time been killed by it, and ſometimes made to diſcover it ſelf during the Lives of thoſe that dealt ſo much in it; of which I elſewhere give ſome Inſtances. Wherefore I ſhall only obſerve at preſent, that 'tis a common Practice, both among Gilders, and ſome Chymiſts, that, when they have occaſion to make an Amalgam, or force away the Mercury from one by the fire, they keep Gold in their Mouthes, which by the Mercurial fumes, that wander through the Air, will now and then,

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by that time 'tis taken out of their Mouths, be turned white almost, as if it had been silver'd over.

A mass of purified Brimstone being sublimed, the ascending fumes will condense into what the Chymists call *Flores Sulphuris*, which is true Sulphur of the same nature with that, formerly exposed to sublimation, and may readily by melting be reduced into such another mass.

And to give you another like Example of dry Bodies, I tryed, that by subliming good Camphire in close vessels, it would all, as to sense, be raised into the upper vessel, or part of the Subliming-glass in the form of dry Camphire as it was before.

Nay though a Body be not by Nature, but Art compounded of such differing Bodies as a Metal, Mineral, and two or three Salts; yet, if upon Purification of the mixture from its grosser parts, the remaining and finer parts be minute enough and fitly shap'd, the whole liquor will ascend, and yet in the Receiver

Receiver altogether recover its priſtine form of a tranſparent Fluid, compoſed of differing Saline and Mineral parts. This is evident in the Diſtillation of what Chymiſts call *Butter*, or *Oyl* of Antimony, very well rectified. For, this Liquor will paſs into the Receiver diaphanous and fluid, though, beſides the Particles of the Sublimate, (which is it ſelf a factitious compounded Body) it abounds with Antimonial Corpuſcles, carried over and kept invisible by the corroding Salts, whatever *Angelus Sala*, and thoſe Chymiſts that follow him, have affirm'd to the contrary, as might be eaſily here proved, if this were a fit place to do it in.

I found by inquiring of an Ingenious perſon, that had an intereſt in a Tin-Mine, that I was not deceived in gueſſing, that Tin it ſelf, though a Metal whoſe Ore is of a very difficult fuſion, and which I have by it ſelf kept long upon the Cupel without finding it to fly away, would yet retain its Metalline nature in the form

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of fumes or flowers. For this experienc'd Gentleman answer'd me, that divers times they would take great store of a whitish Sublimate from the upper part of the Furnaces or Chimnies, where they brought their Ore to fusion, or wrought further upon it; and that this Sublimate, though perhaps elevated to the height of an ordinary Man, would, when melted down, afford at once many Pounds of very good Tin. On which occasion I shall add, that I have my self more than once raised this Metal in the form of white Corpuscles by the help of an Additament, that did scarce weigh half so much as it.

Chap. IV.

THe second way, by which we may discover the Determinate Nature of Effluviums, is, by the difference that may sometimes be observ'd in their Sensible Qualities. For, these

these Effluviums that are endow'd with them, proceed from the same sort of Bodies, and yet those afforded by one kind of Bodies being in many cases manifestly differing from those that fly off from another, this evident disparity in their Exhalations argues their retaining distinct natures, according to those of the respective Bodies whence they proceed.

I will not now stay to examine, whether in the Steams, that are made visibly to ascend from the Terrestrial Globe by those grand Agents and usual raisers of them, the Sun, and the agitation of the Air, the Eye can manifestly distinguish the diversity of colours: But in some productions of Art such different colours may be discovered in the Exhalations, even without the application of any external heat to raise them. For, when Spirit of Nitre, *for example*, has been well rectified, I have often observ'd, that even in the cold the fumes would play in the unfill'd part of the stop'd Vials it was kept in, and appear in

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it of a reddiſh colour, and, if thoſe veſſels were open'd, the ſame fumes would copiouſly aſcend into the Air, in the form of a reddiſh or orange-tawny Smoak. Spirit or Oyl of Salt alſo, if it be very well dephlegm'd, though it will ſcarce in the cold viſibly aſcend in the empty part of a Vial, whilſt it is kept well ſtop'd; yet, if the free Air be allow'd acceſs to it, it will, in caſe it be ſufficiently rectified, fly up in the form of a whitiſh fume. But this is inconſiderable in compariſon of what happens in a volatile Tincture of Sulphur, I have elſewhere taught you to make with Quick-lime. For, not only upon a ſlight occaſion the vacant part of the Vial will be fill'd with white fumes, though the Glaſs be well ſtop'd, but upon the opening the Vial theſe fumes will copiouſly paſs out at the neck, and aſcend into the Air in the form of a Smoak, more white than perhaps you ever ſaw any. And both this and that of the Spirit of Salt-peter do by their operation, as well as ſmell,

diſcloſe what they are; the latter being of a Nitrous nature, (as is confeſs'd) and the former, of a Sulphureous: In ſo much that having for curioſities ſake in a fitly ſhap'd Glaſs caught a competent quantity of the aſcending white fumes, I found them to have conven'd into Bodies tranſparent and Geometrically figur'd, wherein 'twas eaſie to diſcover by their ſenſible qualities, that there were ſtore of Sulphureous particles mixt with the Saline ones. That the liquors of Vegetables, diſtill'd *in Balneo* or in Water, are not wont to retain any thing of the colour of the Bodies that afforded them, is a thing eaſie to be obſerv'd in Diſtillations made without Retorts or the violence of the Fire. But it may be worth while to make tryal, whether the Eſſential Oyl of Wormwood aſcend colour'd like the Plant, whence 'tis firſt drawn over with Water in the Limbec, or rectified *in Balneo*. For, I forgot to take notice of it, when upon ſome particularities, I obſerv'd in that Plant,

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my curiosity led me to find, that not only in the first distillation in a Copper Limbec, tinn'd on the inside, the Oyl came over green, but by a rectification purposely made in a Glass-vessel, the purified liquor was not depriv'd of that colour.

The mention of these Essential Oyls, as Chymists call those that are drawn in Limbecs, leads me to tell you, that, though these liquors be but *Effluvia* of the Vegetables they are distill'd from, condens'd again in the Receiver into liquors; yet, as subtile as they are, many of them retain the genuine taste of the Bodies, whence the heat elevated them; as you will easily find, if you will taste a few drops of the Essential Oyl of Cinamon, *for example*, or of Wormwood dissolv'd by the intervention of Sugar or Spirit of Wine in a convenient quantity of Water, Wine, or Beer. For, by this means you have the natural taste of this Spice or Herb. And Wormwood is a Plant, whose *Effluvia* do so retain the nature of the Body that parts with

them, that I must not forbear to alledge here an Observation of mine, that may shew you, that 'tis possible, though not usual, that even without the help of the Fire the expirations of a Body may communicate its taste. For, among other things, that I had occasion to observe about some quantity of Wormwood laid up together, I remember, I took notice, and made others do the like, that coming into a room, where 'twas kept, not only the organs of smelling were powerfully wrought upon by the Corpuscles that swarm'd in the Air, but also the Mouth was sensibly affected with a bitter taste. Perhaps you will scarce think it worth while, that after this instance I should add, that I found the expirations of *Amber*, kept a while in pure Spirit of Wine, taste upon the tongue like Amber it self, when I chew'd it between my teeth. But I choose to mention this instance, because it will connect those lately mention'd with another sort, very pertinent to our present purpose. For,

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the expirations that I have obtain'd from Amber, both with pure Spirit of Wine, and a more piercing *Menſtruum*, did manifeſtly retain in both thoſe liquors a peculiar ſmell, with which I found it to affect the Noſtrils, when, for tryals ſake, I excited the Electrical faculty of Amber by rubbing. And as for Odours, 'tis plain, that the Eſſential Oyls of Chymiſts, well drawn, do many of them retain the peculiar and genuine ſent of the Spices or Herbs that afforded them. And that theſe Odours do really conſiſt of, or reſide in certain inviſible Corpuſcles that fly off from the viſible Bodies, that are ſaid to be endow'd with ſuch Smells, I have elſewhere prov'd at large; and it may ſufficiently appear from their ſticking to divers of the Bodies they meet with, and their laſting adheſion to them.

Other Examples may be given of the ſetled difference of Effluviums directly perceivable by Humane Organs of Senſe, as dull as they are;

which laſt expreſſion I add, becauſe I ſcarce doubt, but that, if our Senſories were ſufficiently ſubtile and tender, they might immediately perceive in the ſize, ſhape, motion, and perhaps colour too of ſome now inviſible Effluviums, as diſtinguiſhable differences, as our naked Eyes in their preſent conſtitution ſee, between the differing ſorts of Birds, by their appearances, and their manner of flying in the Air, as Hawks, and Partridges, and Sparrows, and Swallows. To make this probable I will not urge, that in fine white Sand, whoſe grains by the unaſſiſted Eye are not wont to be diſtinguiſhed by any ſenſible Quality, I have often obſerv'd in an excellent Microſcope, a notable diſparity as to bulk, figure, and ſometimes as to colour: And that in ſmall Cheeſe-mites, which the naked Eye can very ſcarcely diſcern, ſo far is it from diſcovering any difference between them, one may (as was noted in the laſt eſſay) plainly ſee, beſides an obvious difference in point of bigneſs,

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many particular parts, on whoſe accounts the ſtructure of thoſe *moving points* may difference them from each other. And I have ſometimes ſeen a very evident diſparity even in point of ſhape between the very Eggs of theſe *living Atoms*, (as a Poet would perhaps ſtile them.) But theſe kinds of proofs (as I was ſaying) I ſhall forbear to inſiſt on, that I may proceed to countenance my conjecture by the effects of the Effluviums, that are properly ſo call'd, upon Animals.

And firſt, though the Touch be reckon'd one of the moſt dull of the five Senſes, and be reputed to be far leſs quick in Men than in divers other Animals; yet the groſs Organs of that, may, in Men themſelves, even by accident, be ſo diſpos'd, as to be ſuſceptible of impreſſions from *Effluvia*: Of this in another Paper I give ſome Inſtances. And I know not whether divers of the Preſages of Weather to be obſerv'd in ſome Animals, and the Aches and other pains, that, in many crazy and wounded

men, are wont to fore-run great changes of Weather, do not often (for I do not ſay alwayes) proceed (at leaſt in part) from inviſible and yet incongruous Effluxions, which, either from the ſubterraneal parts, or from ſome Bodies above ground, do copiouſly impregnate the Air. And on this occaſion it will not be impertinent to mention here what an experienc'd Phyſician being (if I much miſremember not) the Learned *Dimmerbrook*, relates concerning himſelf, who having been infected with the Plague by a Patient that lay very ill of it, though by Gods bleſſing, which he particularly acknowledges, upon a ſlight but ſeaſonable Remedy, he was very quickly cured, and that without the breaking of any Tumor, yet it left ſuch a change in ſome parts of his Body, that he ſubjoyns this memorable paſſage; *Ab illo periculo ad contagioſos mihi appropinquanti in emunctoriis ſucceſſit dolor, vix fallax Peſtis indicium.*

Two or three other Obſervations of

of the like nature you meet with in another of my Papers *. And I ſhall now add, that I know an ingenious Gentlewoman (Wife to a famous Phyſician) who was of a very curious and delicate complexion, that has ſeveral times aſſur'd me, that ſhe can very readily diſcover, whether a perſon, that comes to viſit her in Winter, came from ſome place where there is any conſiderable quantity of Snow; and this ſhe does, (as ſhe tells me) not by feeling any unuſual cold (for if the ground be frozen but not cover'd with Snow, the Effect ſucceeds not,) but from ſome peculiar impreſſion, which ſhe thinks, ſhe receives by the organs of Smelling. I might add, that I know alſo (as I may have formerly told you) a very ingenious Phyſician, who falling into an odd kind of Feaver, had his ſenſe of Hearing thereby made ſo very nice and tender, that he very plainly heard ſoft whiſpers, that were made at a conſiderable diſtance off, and which were not

* *Abous* Cosmical Suſpitions.

not in the leaſt perceiv'd by the healthy by-ſtanders, nor would have been by him before his ſickneſs. Which (ſickneſs) I mention as the thing, that gave his organs of Hearing this preternatural quickneſs, becauſe when the Feaver had quite left him, he was able to hear but at the rate of other men. And I might tell you too, that I know a Gentleman of eminent parts and note, who, during a diſtemper he had in his Eyes, had his organs of Sight brought to be ſo tender, that both his friends and himſelf alſo have aſſur'd me, that when he wak'd in the Night he could for a while plainly ſee and diſtinguiſh Colours, as well as other objects, diſcernable by the Eye, as was more than once try'd, by pinning Ribbands or the like Bodies of ſeveral colours, to the inſide of his Curtains in the dark. For if he were awaken'd in the Night, he would be able to tell his bed-fellow, where thoſe Bodies were plac'd, and what colour each of them was of.

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I have mention'd theſe Inſtances only to ſhew you, that if our Senſories were more delicate and quick, they would be ſufficiently affected by Objects, that, as they are generally conſtituted, make no impreſſions at all upon them. For otherwiſe I know, that the *Species* (as they call them) both of Sounds and Colours, are not held by many of the Moderns, (from whom in that I diſſent not,) to be ſo much corporeal Effluxions, trajected through the *medium*, as peculiar kinds of Local Motion convey'd by it. Therefore I ſhall now confirm the conjecture I would countenance by the diſcrimination made by the organs of other Animals of ſuch *Effluvia* as to us men are not only inviſible but inſenſible. And therefore partly to ſtrengthen what I deliver'd, and partly to confirm what I am now diſcourſing of, it will not be impertinent to ſubjoyn two or three Relations, that I had from perſons of very good credit, whom I thought likely to make me no unſatisfactory returns

to

to my Queſtions about things they were very well vers'd in.

A perſon of Quality, to whom I am near allied, related to me, that to make a tryal, whether a young Blood-hound was well inſtructed, (or as the Huntſmen call it, *made*) he caus'd one of his Servants, who had not kill'd, or ſo much as touch'd any of his Deer, to walk to a Countrey-town, four Mile off, and then to a Market-town three Miles diſtant from thence; which done, this Nobleman did, a competent while after, put the Blood-hound upon the ſcent of the man, and caus'd him to be follow'd by a Servant or two, the Maſter himſelf thinking it alſo fit to go after them to ſee the event; which was, that the Dog, without ever ſeeing the Man he was to purſue, follow'd him by the ſcent to the above-mentioned places, notwithſtanding the multitude of Market-people that went along in the ſame way, and of Travellers that had occaſion to croſs it. And when the Blood-hound came to the chief

chief Market-town, he paſs'd through the ſtreets, without taking notice of any of the people there, and left not till he had gone to the Houſe, where the Man, he ſought, reſted himſelf, and found him in an upper Room to the wonder of thoſe that follow'd him. The particulars of this Narrative the Nobleman's Wife, a perſon of great veracity, that happen'd to be with him when the tryal was made, confirm'd to me.

Enquiring of a ſtudious perſon, that was Keeper of a Red-dear-park and vers'd in making Blood-hounds, in how long time, after a Man or Deer had paſs'd by a graſſy place, one of thoſe Dogs would be able to follow him by the ſcent? He told me, that it would be ſix or ſeven Hours: Whereupon an ingenious Gentleman, that chanc'd to be preſent, and liv'd near that Park, aſſur'd us both, that he had old Dogs of ſo good a ſcent, that if a Buck had the day before paſs'd in a Wood, they will, when they come where the ſcent lies, though

though at ſuch a diſtance of time after, preſently find the ſcent and run directly to that part of the Wood where the Buck is. He alſo told me, that though an old Blood-hound will not ſo eaſily fix on the ſcent of a ſingle Deer, that preſently hides himſelf in a whole herd; yet if the Deer be chas'd a little till he be heated, the Dog will go nigh to ſingle him out, though the whole herd alſo be chas'd. The above-nam'd Gentleman alſo affirm'd, that he could eaſily diſtinguiſh whether his Hounds were in chaſe of a Hare or a Fox by their way of running, and their holding up their Noſe higher than ordinary when they purſue a Fox; whoſe ſcent is more ſtrong. Theſe Relations will not be judg'd incredible by him that reflects on ſome of the Inſtances that have already (in the foregoing Eſſay) been given of the ſtrange ſubtilty of *Effluvia*: To which I ſhall now add, that I remember, that to try whether I could in ſome meaſure make Art imitate Nature, I prepared a Body of

of a vegetable ſubſtance, which, though it were actually cold, and both to the Eye and Touch dry, did for a while emit ſuch determinate and piercing, though inviſible, Exhalations, that having for Tryals ſake applied to it a clear Metalline Plate (and that of none of the very ſofteſt kind neither) for about one Minute of an Hour, I found, that, though there had been no immediate contact between them, I having purſpoſely interpoſed a piece of Paper to hinder it; yet there was imprinted on the ſurface of the Plate a conſpicuous ſtain of that peculiar colour, that the Body, with whoſe Steams I had imbued the vegetable ſubſtance, was fitted to give a Plate of that mix'd Metal. And though it be true, that in ſome circumſtances, the lately mention'd Inſtances about Blood-hounds have a conſiderable advantage of this I have now recited; yet that advantage is much leſſen'd, not to ſay countervail'd, by ſome circumſtances of our Experiment. For, not to repeat, that

that the emittent Body was firm and cold, the Effect produced by the Effluvium that guided the Setting-dog, was wrought upon the Senſory of a living and warm Animal; and ſuch an one, whoſe organs of Smelling are of an extraordinary tender Conſtitution above thoſe of Men and other Animals, and probably the Impreſſion was but tranſient; whereas in our caſe the inviſible Steams of the vegetable ſubſtance wrought upon a Body which was of ſo ſtrong and inorganical a Texture as a (compounded) Metal, though it were fenc'd by being lapt up in Paper, notwithſtanding which theſe Steams invaded it in ſuch numbers, and ſo notably, as to make their Operation on it manifeſt to the Eye, and conſiderably permanent too; ſince coming to look upon the Plate after the third day, I found the induced Colour yet conſpicuous, and not like ſuddenly to vaniſh.

Hitherto in this *Chapter* I have argued from the conſtant and ſetled

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difference of the ſenſible Qualities of Effluviums, that they do not always loſe their diſtinct natures, when they ſeem to have loſt themſelves by vaniſhing into Air. But before I diſmiſs this Subject, I muſt conſider an Objection, which I know may be made againſt the Opinion we have been countenancing. For it may be alledg'd, that there may be many caſes, wherein the Effluviums of Bodies are, in their paſſage through the Air, ſenſibly alter'd, or do affect the Organs of ſenſe otherwiſe than each kind of them apart would do: Nor is this difficulty altogether irrational. For it ſeems conſonant enough to Experience, that ſome ſuch caſes ſhould be admitted, and therefore in the foregoing Diſcourſe I have, where I thought it neceſſary, forborn to expreſs my ſelf in ſuch general and abſolute terms, as otherwiſe I might have done. But, as for ſuch caſes as I have inſiſted upon, and many more, I ſhall now repreſent, that the objected alterations need not hinder, but that

Effluviums at their firſt parting from the Bodies, whence they take wing (if I may ſo ſpeak,) may retain as much of the nature of thoſe Bodies, as we have aſcribed to them; ſince the ſubſequent change may very probably be deduc'd from the combinations or coalitions of divers Steams aſſociating themſelves in the Air, and acting upon the Senſory, either altogether and conjointly, or at leaſt ſo near it, that the Senſe cannot perceive their Operations as diſtinct. This I ſhall elucidate, but not pretend to prove, by what happens in Sounds and Taſts. For if, by way of inſtance, in a Muſical inſtrument, two ſtrings tun'd to an eigth, be touch'd together, they will ſtrike the Ear with a ſound, that will be judg'd one, as well as pleaſing, though each of the trembling ſtrings make a diſtinct noiſe, and the one vibrates as faſt again as the other. And if, into Oyl of Tartar *per Deliquium*, you drop a due proportion of Spirit of Nitre, and exhale the ſuperfluous moiſture, the

the Acid and Alcalizate Corpuſcles, that were ſo ſmall as to ſwim inviſibly in thoſe liquors, will convene into Nitrous Concretions, whoſe taſt will be compounded of, but very differing from, both the taſts of the Acid and Tartareous Particles, which Particles may yet, for the moſt part, by a skilful Diſtillation, be divorc'd again. And ſo, if to a ſtrong ſolution of Pot-aſhes or Salt of Tartar you put as much in weight of *Sal Armoniack*, as there is of either of thoſe fixt Salts contain'd in the liquor; you may, beſides a ſubtil Urinous Spirit that will eaſily come over in the diſtillation, obtain a dry *Caput mortuum*, which is almoſt totally a compounded Salt, differing enough from either of the ingredients, eſpecially the Alcalizate, as well in Taſt as in ſome other Qualities: This Salt (free'd from its *faces*) being that Diuretick Salt, I ſeveral years ago gave quantities of, to ſome Chymiſts and Phyſicians, from the moſt of whom I received great thanks, accompanied

with the (more acceptable) accounts of the very happy ſucceſs they had employed it with, though uſually but in a ſmall Doſe, as from ſix, eight or ten Grains to a Scruple. But this being mentioned only upon the by, I ſhall proceed to tell you, that, ſince I intimated to you already, that I would mention Examples of *Sounds* and *Taſts* only to illuſtrate what I had been delivering; I ſhall now add ſome Inſtances by way of Proof, of the Coalition and reſulting change of Steams in the Air. 'Tis eaſily obſervable in ſome Noſe-gays, where the differing Flowers happen to be conveniently mix'd, that in the ſmell afforded by it, at a due diſtance, the Odours of the particular Flowers are not perceiv'd, but the Organ is affected by their joynt-action, which makes on it a confuſed but delightful impreſſion. And ſo, when in a Ball of Pomander, or a perfum'd Skin, Musk, and Amber, and Civet, and other ſweets are skilfully mix'd, the coalition of the diſtinct *Effluvia* of the ingre-

ingredients, that aſſociate themſelves in their paſſage through the Air, produce in the Senſory one grateful perfume, reſulting from all thoſe Odours. But if you take Spirit of fermented Urine and Spirit of Wine, both of them Phelgmatick, and mix them together, they will incorporate like Wine and Water, or any other ſuch liquors, without affording any dry concretions. But if you expoſe them in a convenient Veſſel but to the mild heat of a Bath or Lamp, the aſcending Particles will aſſociate themſelves, and adhere to the upper part of the Glaſs in the form of a white but tender Sublimate, conſiſting both of Urinous and Vinous Spirits, aſſociated into a mixture, which differs from either of the liquors, not only in Conſiſtence, Taſt and Smell, but in ſome conſiderable Operations performable by this odd mixture; which, this is not the place, to take further notice of. And if Spirit of Salt and Spirit of Nitre be, by Diſtillation, elevated in the form of Fumes,

ſo order'd as to convene into one liquor in the Receiver, this liquor will readily diſſolve crude Gold, though neither the Spirit of Nitre alone, nor that of Salt would do ſo.

And that you may have an ocular proof of the Poſſibility of the diſtinctneſs and ſubſequent Commixture of Steams in the Air; I ſhall now add an Experiment, which I long ſince devis'd for that purpoſe, and which I ſoon after ſhew'd to many curious perſons, moſt of whom appear'd ſomewhat ſurpriz'd at it. The Experiment was; that I took two ſmall Vials, the one fill'd with Spirit of Salt, but not very ſtrong; the other with Spirit of fermented Urine or of *Sal Armoniack* very well rectified: Theſe Vials being plac'd at ſome diſtance, and not being ſtop'd, each liquor afforded its own ſmell, at a pretty diſtance, by the Steams it emitted into the Air, but yet theſe Steams were inviſible. But when theſe Vials, (which ſhould be of the ſame ſize) came to be approach'd very

very near to each other, though not ſo, as to touch; *as* when the two liquors are put together in the form of liquors, they will notably act upon one another; *ſo* their reſpective Effluviums meeting in the Air, would, anſwerably to the littleneſs of their bulk, do the like, and, by their mutual occurſions, become manifeſtly viſible, and appear moving in the Air like a little portion of Smoak or of a Miſt, which would quickly ceaſe, if either of the Vials were remov'd half a Foot or a Foot from the other. And I remember, that, to add to the oddneſs of the *Phænomenon*, I ſometimes made a drop of the Spirit of Salt hang at the bottom of a little ſtick of Glaſs or ſome other convenient Body, and held this drop thus ſuſpended in the Orifice of a Vial that had Spirit of *Sal Armoniack* in it, and was furniſh'd with a ſomewhat long neck; for by this means it happen'd, as I expected, that the aſcending Urinous Particles, though inviſible before, invading plentifully the

Acid ones of the drop, produced a notable Smoak, which, if the drop were held a little above the neck of the Glaſs, would moſt commonly fly upwards to the height of a Foot or half a Yard: But if the drop were held ſomewhat deep within the Cavity of the neck, a good part of the produced Smoak would oftentimes fall into the Cavity of the Vial, which was left in great part empty, ſometimes in the form of drops, but uſually in the form of a ſlender and ſomewhat winding ſtream of a white colour, that ſeem'd to flow down juſt like a Liquor from the depending drop, till it had reach'd the Spirit of *Sal Armoniack*; upon whoſe ſurface it would ſpread it ſelf like a Miſt. But this only upon the by. As for the main Experiment it ſelf, it may be, as I have found, ſucceſsfully try'd with other Liquors than theſe; but 'tis not neceſſary in this place to give an account of ſuch Tryals; though perhaps, if I had leiſure, it might be worth while to conſider, whether

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theſe Coalitions of differing ſorts of Steams in the Air, and the Changes reſulting thence of their particular precedent Quantities, may not aſſiſt us to inveſtigate the cauſes of divers ſudden Clouds and Miſts, and ſome other Meteorological *Phænomena*, and alſo of divers changes that happen in the Air in reference to the coming in and ceaſing of ſeveral either Epidemical or contagious Diſeaſes, and particularly the *Plague*, that ſeem to depend upon ſome occult temperature and alterations of the Air, which may be copiouſly impregnated by the differing ſubterraneal (not to add here, Sidereal) Effluviums, that not unfrequently aſcend into it (or otherwiſe invade it,) with Peſtiferous or other Morbifick Corpuſcles, and *ſometimes* with others of a contrary Nature, and *ſometimes* too perhaps, neither the one ſort of Steams, which may be ſuppos'd to have imbued the Air, is in it ſelf *deleterious*; nor the other *ſalutary*, but becomes ſo upon their caſual coalition in the Air. You will

will perhaps think this Conjecture of the reſultancy of peſtilential Steams, the leſs improbable, if I here add that odd Obſervation, which was frequently made in the formerly mentioned Plague at *Nimmegen* by a Phyſician ſo Judicious as * *Dimmerbrook*, whoſe words are theſe; *Illud notatu dignum ſæpiſſimè obſervavimus, nempe in illis ædibus in quibus nulla adhuc peſtis erat, ſi linteamina ſordida aquâ & ſapone noſtrate (ut in Belgio moris eſt) illic lavarentur, eo ipſo die, vel interdum poſtridie, duos tres-ve ſimul peſte correptos fuiſſe, ipſique ægri teſtabantur fœtorem aquæ ſaponatæ illis primam & maximam alterationem intuliſſe. Hoc ipſum quoque in meo ipſius hoſpitio infelix experientia docuit, in quo poſt lota linteamina ſtatim gravem alterationem perceperunt plerique domeſtici, & proximè ſequenti nocte tres peſte correptæ, ac brevi poſt mortuæ fuere.* I omit the Inſtances he further ſets down to confirm this odd *Phænomenon*, of which, though perhaps ſome other

* *Tract. de* Peſte, *lib.* 2. *cap.* 3.

other Cauſe may be deviſed, yet that I lately aſſign'd ſeems at leaſt a probable one, if not the moſt probable; ſince, as 'tis manifeſt by daily experience, that the ſmell occaſion'd by the waſhing of foul Linnen with the Soap commonly uſed in the *Netherlands*, produces not the Plague; ſo by our Learned Author's Obſervation it appears, either that there were not yet any Peſtilential Effluxions in the Air of thoſe places, which on the occaſions of thoſe waſhings became infected, or at leaſt that by the addition of the fetid *Effluvia* of the ſoapy Water, thoſe Morbifick Particles, that were diſpers'd through the Air before, had not the power to introduce a malignant conſtitution into the Air, and to act as truly Peſtilential, till they were enabled to do ſo by being aſſociated with the ill-ſcented *Effluvia* of the Soap.

Whether alſo Salutary, and, if I may ſo call them, Alexipharmacal Corpuſcles may not be produc'd in the Air by Coalition, might be very well

well worth our Enquiry: Especially if we had a competent Historical Account of the yearly ceasing of the Plague at *Grand Cayro*. For, as I have elsewhere noted out of the Learned *Prosper Alpinus*, who practis'd Physick there; and as I have also been inform'd by some of my Acquaintance who visited that vast City, that almost in the midst of Summer as soon as the River begins to rise*, the Plague has its malignity suddenly check'd, even as to those that are already infected, and soon after ceases; so if other Circumstances contradict not, one might guess, that this strange *Phænomenon* may be chiefly occasion'd by some Nitrous or other Corpuscles that accompany the overflowing *Nile*, and by associating themselves with what *Hippocrates*

* *The Plague which here miserably rageth upon the first of the Flood doth instantly cease; in so much as when five Hundred dye at Cayro the day before, which is nothing rare, (for the sound keep company with the sick, holding Death fatal, and, to avoid them, Irreligion,) not one doth dye the day following*; says Mr. *Sandys* in his Travels, *Lib.* 2.

crates ſomewhere calls νοσερὰς ἀναθυμιάσεις, diſable them to produce their wonted pernicious Effects. To which Hypotheſis ſuits well what is deliver'd by more than one Traveller into *Egypt*, and more particularly by our Ingenious Countreyman Mr. *George Sandys*, who not only takes notice, that about the time of the overflowing of *Nilus*, whoſe abounding with Nitre has been obſerved even by the Antients, there is a certain moiſtening Emanation diffus'd thorow the Air. *To prove*, ſayes he*, ſpeaking of the overflowing of *Nilus*, that it proceedeth from a natural Cauſe, this one, though ſtrange, yet true Experiment will ſuffice. Take of the Earth of *Egypt* adjoining to the River, and preſerve it carefully, that it neither come to be wet nor waſted, weigh it daily, and you ſhall find it neither more nor leſs heavy until the ſeventeenth of *June*, at which day it beginneth to grow more ponderous, and augmenteth

* *Mr.* Sandys *in the Book above-cited.*

menteth with the augmentation of the River, whereby they have an infallible knowledge of the ſtate of the Deluge, proceeding without doubt from the Humidity of the Air, which having a recourſe through all paſſible places, and mixing therewith increaſeth the ſame, as it increaſeth in moiſture.

That theſe Sanative Steams perform their Effects meerly becauſe they are moiſt, I preſume Naturaliſts will ſcarce pretend; but that they may be of ſuch a nature as by their Coalition with the Morbifick Corpuſcles to increaſe their Bulk and alter their Figure, or precipitate them out of the Air, or clog their Agility, or pervert their Motions, and in a word deſtroy all or ſome at leaſt of thoſe Mechanical Affections which made thoſe Corpuſcles Peſtilential: That, I ſay, theſe Antidotal Vapours (if I may ſo call them) may have theſe Effects upon thoſe that formerly were Morbifick, and that ſo there may reſult from the Aſſociation of

two

two ſorts of Particles, whereof one was of a highly noxious nature, a harmleſs mixture, might here be made probable by ſeveral things; but that I hope what I have lately recited about the Coalitions of the *Effluvia* of Spirit of Salt and of Urine (Liquors known to be highly contrary to each other) is not already forgotten by you.

And the Experiment with which I am to conclude this Eſſay will perhaps make you think it poſſible, that the Peſtiferous Steams that have already paſs'd out of the Air, and invaded, but not too much vitiated, the Bodies of Men, may have their malignity much debilitated by the ſupervening of theſe Antidotal Particles. For in that Experiment you will find, that the Steams emitted into the Air from the Liquor there deſcribed, though that were actually cold, were able to reach, and manifeſtly to Operate, (and that probably by way of Præcipitation,) upon Corpuſcles that were fenc'd from them by

by the Interpoſition of other Bodies, not more porous than thoſe of living Men. Whether the fume of Sulphur, which by many is extoll'd to prevent the Infection of the Air, do by its acid or other Particles diſarm, if I may ſo ſpeak, the Peſtilential ones, I have not now time to inquire: No more than whether in *Ireland* and ſome few other Countries, that breed or brook no poyſonous Animals, that hoſtility may proceed, at leaſt in great part, from the peculiar Nature of the Soyl, which both from its ſuperficial and deeper parts, conſtantly ſupplies the Air with Corpuſcles deſtructive to venemous Animals. And ſome other Particulars, that may be pertinently enough conſider'd here, you may find treated on in other Papers. And therefore at preſent I ſhall only intimate in a word, that having purpoſely made a viſible and laſting Stain on a ſolid Body barely by cold *Effluvia*, I did by the inviſible and cold Steams of another Body make in two or three Minutes a viſible

viſible change in the colour of that Stain.

And as for the other part of the Conjecture, (*viz.*) That Meteors may ſometimes be produc'd by the Occurſions of Subterraneal *Effluvia*, ſome of them of one determinate Nature, and ſome of another, I think I could, to countenance it, give you divers Inſtances of the plentiful Impregnation of the Air at ſome times, and in ſome places, with Steams of very differing Natures, and ſuch as are not ſo likely to be attracted by the Heat of the Sun, as to be ſent up from the Subterraneal Regions, and ſometimes from Minerals themſelves. But for Inſtances of this kind, I ſhall, for brevities ſake, refer you to another Paper*, where I have purpoſely treated of this Subject, and particularly ſhewn, That though uſually the Effluxions that come from under ground are ill-ſcented, yet they are not alwayes ſo; and alſo that Sul-

* *An Eſſay of* Subterraneal Exhalations.

phureous Exhalations even from cold, and, for the moſt part, Aqueous Liquors may retain their determinate nature in the Air, and act accordingly upon ſolid Bodies themſelves, to whoſe Conſtitution thoſe *Effluvia* chance to be proportionate.

But one memorable Story not mention'd in that Diſcourſe is too much to our preſent purpoſe to be here omitted, eſpecially having met with it in ſo approved an Author as the experienc'd *Agricola*, who having mention'd out of antient Hiſtorians the Raining of White and Red liquors, which they took (erroneouſly I doubt not) for Milk and Blood, ſubjoyns, * *Ut autem majorem fidem habeamus Annalium monumentis facit res illa decantata, quæ Patrum memoriâ* (in another place he ſpecifies the Year of our Lord) *in* Suevia *accidit; Aer enim ille ſtillavit guttas, quæ lineas veſtes cruentis rubris quaſi ſanguineis imbuebant.* Which I the rather mention, becauſe it does

* *Agric.* de Nat. eorum quæ effluunt è Terra, *Lib.* 12. *pag.* 236.

not

not only prove what I alledge it for; but may keep, what is lately and very credibly reported to have happen'd in divers places of the Kingdom of *Naples* ſoon after the Fiery Eruption of *Veſuvius*, from being judg'd a *Phænomenon* either altogether fabulous, (as doubtleſs many have thought it,) or a Prodigie without all example, as is preſum'd even by thoſe that think it not miraculous. And to this I add, that 'twill be the leſs improbable, that the more agile Corpuſcles of Subterraneal Salts, Sulphurs and Bitumens, may be rais'd into the Air, and keep diſtinct natures there, if ſo fixt a Body as common Earth it ſelf can be brought to ſwim in the Air. And yet of this the worthy Writer newly quoted gives us, beſides what Annals relate, this Teſtimony upon his own knowledge: * *Certè hîc Kempnicii undecimum abhinc annum menſe Septembri effluxerunt imbres, ſic cum terra lutea*

* *Agric. de Nat. eorum quæ è Terra effluunt, Lib. 12. pag. 263.*

commiſti, ut eâ paſſim plateas ſcilicet ſtratas viderem conſperſas.

And to ſhew you that in ſome caſes the Particles even of Vegetable Bodies may not ſo ſoon periſh in the Air as they vaniſh there, but may retain diſtinct natures at a greater diſtance, than one would think, from the Bodies that copiouſly emit them; I ſhall add, that having deſir'd an ingenious Gentleman, that went on a conſiderable Employment to the *Eaſt-Indies*, to make ſome Obſervations for me in his Voyage; he ſent me among other things this Remarque: That having ſayl'd along the Coaſt of *Ceylon*, (famous for Cinnamon-trees and well-ſcented Gums,) though they Coaſted it almoſt a whole day, the Wind, that then chanc'd to blow from the ſhoar, brought them a manifeſtly odoriferous Air from the Iſland, though they kept off many miles (perhaps twenty or twenty-five) from the ſhoar. Nor ſhould this be thought incredible, becauſe the diffuſion ſeems ſo diſproportionate to

that

that of other Bodies diſſolved by Fluids; as, for inſtance, though Salt be an active Body and reſoluble into abundance of minute Particles, yet one part of Salt will ſcarce be taſtable in an hundred parts of Water. For ſenſibly to affect ſo groſs an Organ as that of our Taſt, there is uſually required in ſapid Particles a bigneſs far exceeding that which is neceſſary to the making Bodies fit Objects for the ſenſe of Smelling, and, which is here mainly to be conſidered, there is a great difference between the power a Body has to impregnate ſo thin and fine a Fluid as Air, whoſe parts are ſo rare and lax, and that which it has to impregnate Liquors, ſuch as Water or Wine, whoſe parts are ſo conſtipated as to make it not only viſible and tangible, but ponderous. On which occaſion I remember that having had a Curioſity to try how far a ſapid Body could be diluted without ceaſing to be ſo, I found by Tryal, that one drop of good Chymical, and, as Artiſts call it, Eſſential

Oyl of Cinnamon being duly mix'd by the help of Sugar with Wine, retain'd the determinate taſt of Cinnamon, though it were diffus'd into near a quart of Wine. So that making a moderate eſtimate, I concluded, that upon the common ſuppoſition, according to which a drop is reckon'd for a Grain, one part of Oyl had given the ſpecifick Taſt of the Spice, it was drawn from, to near fourteen thouſand parts of Wine. By comparing which Experiment with what I noted about the proportion of Salt requiſite to make Water taſt of it, you will eaſily perceive; that there may be a very great difference in point of diffuſivenels between the little Particles that make Bodies ſapid: Which may ſerve to confirm both ſome part of the *firſt Chapter* of the foregoing Eſſay of the Subtilty of *Effluvia*, and what I was lately ſaying to ſhew it poſſible, that Antimonial Glaſs might impart ſtore of Steams to the Emetick Wine, without appearing upon common Scales to have loſt of its weight;

weight; ſince we ſee, that one Drop of ſo light a Body as Oyl may communicate not inſenſible *Effluvia*, but taſtable Corpuſcles to near a Quart of Liquor. But this is not all for which I mention our Experiment: for I muſt now add, that beſides the almoſt innumerable Sapid parts of a ſpicy Drop communicated to the Wine, it thence diffuſed a vaſt number of odorous Particles into the Air, which both I, and others perceived to be imbued with the diſtinct ſcent of Cinnamon, and which perhaps the Liquor would have been found able to have Aromatized for I know not how long a time, if I had had leiſure to proſecute the Obſervation.

Chap. V.

THE third and laſt way I ſhall mention of ſhewing the Determinate Nature of Effluviums, is to

be taken from the Conſideration of their Effects upon other Bodies than the Organs of our Senſes; (for of their Operations upon theſe we have already ſpoken in the foregoing *Chapter.*) For the Effects, that certain Bodies produce on others by their Effluviums, being conſtant and determinate, and oftentimes very different from thoſe, which other Agents by their Emiſſions work upon the ſame and other ſubjects, the diſtinct nature of the Corpuſcles emitted may be thence ſufficiently gather'd.

We may from the foregoing Tract of the Subtilty of *Effluvia*; borrow ſome Inſtances very pertinent to this place. For the temporary benumbedneſs or ſtupefaction, for example, produc'd in the Fiſherman's Foot by the *Effluvia* * of the Fiſh (*Amoreatim*) mention'd by the Ingenious *Piſo*, manifeſts, that thoſe ſtupifying Emanations retain'd a peculiar and venemous nature during their whole paſſage through

* *See the Eſſay of the* Subtilty *of* Effluviums, *Chap.* 4.

through the Shoe, Stocking and Skin, interpos'd betwixt the Fish and the nervous part of the Foot benumb'd by it. And though there are very few other Bodies in the World, that are minute enough to pass through the pores of Glass, 'tis apparent, by the Experiment there recited of the oblong Iron Hermetically seal'd up in a Glass-pipe, that the Magnetical *Effluvia* of the Earth may retain their peculiar and wonderful nature in a smallness that qualifies them to pass freely through the pores of Glass it self.

But that I may neither repeat what you have already met with in the foregoing Tract, nor anticipate what I have to say in the next; I will employ in this *Chapter* some Instances that may be spar'd from both.

That divers Bodies of a Venemous nature may exercise some such Operations upon others by their Effluviums transmitted through the Air, as they are wont to do in their gross substance, is a Truth, whereof though

I have

I have not met with *many*, yet I have met with *ſome* Examples among Phyſicians.

The Learned * *Sennertus* obſerves as a known thing, that the Apprentices of Apothecaries have been caſt into profound Sleeps, when in diſtilling *Opiat* and *Hypnotick* Liquors they have received in at their Noſtrils the Vapours exhaling from thoſe Bodies.

* *Lib. 6. parte 7. cap. 1.*

'Tis recorded by the * Writers about Poyſons, that the root and juyce of *Mandragora* caſts thoſe, that take it, into a deep *Sopor* not unlike a Lethargy. And though the Apples of the ſame Plant be thought to be much leſs malignant; yet *Levinus Lemnius* relates that it happen'd to him more than once, that having laid ſome Mandrake-Apples in his Study, he was by their Steams made ſo ſleepy, that he could hardly recover himſelf; but the Apples being taken away he regain'd

* *In Explicatione Herbarum Biblicarum, cap. 2.*

regain'd alacrity, and threw off all drowſineſs.

Among all Poyſons there is ſcarce any whoſe *Phænomena* are in my opinion more ſtrange than thoſe that proceed from a mad Dog; and yet even this Poyſon, which ſeems to require Corpuſcles of ſo odd and determinate a nature, is recorded by Phyſicians to have been conveyed by Exhalations. *Aretæus* writes (as a Learned modern quotes him,) *Quòd à rabido cane, qui in faciem, dum ſpiritus adducitur, tantummodò inſpiraverit, & nullo modo momorderit, in rabiem homo agatur.* And as there are relations, among Phyſicians, of Animals, that have become *Rabioſi* by having eaten of the parts or excrements of rabid Animals; ſo * *Celius Aurelianus*, who writes, that ſome have been made to run mad, not by being bitten, but wounded only with the Claws of a mad Dog, tells us alſo of a man, that fell into a *Hydrophobia* (which is wont to be a high degree

* *Libro 3. Acutor. Morbor.*

degree of the *Rabies*, and by ſome of the antienter Writers was employ'd to ſignifie that Diſeaſe) without being bitten by a mad Dog, but infected *ſolo odore ex rabido cane attracto*. By which Odours in this and other Narratives of Poyſons I underſtand not a bare Scholaſtick *ſpecies*, but a ſwarm of *Effluvia*, which moſt commonly are all or at leaſt ſome of them odorous. And though it may juſtly ſeem ſtrange to many, that the Venom of a mad Dog ſhould be communicated otherwiſe than by biting, which is ſuppos'd to be the only way he can infect by, it may appear leſs improbable, becauſe *Matthæus de Gradibus* names a perſon, who, he ſays, prov'd infected after many days, by only having put his Hand into the Mouth of a mad Dog, who did not bite him. And the formerly mentioned *Matthiolus* relates, that he ſaw two, that were made rabid without any wound by the ſlabber of a mad Dog, with which they had the misfortune to be beſmear'd.

* *Sen-*

**Sennertus* himſelf affirms of a Painter of his acquainance, that, when he had open'd a Box, in which he had long kept included *Realgar*, a noxious Mineral, ſometimes uſed by Painters and not unknown to Chymiſts, and had unfortunately ſnuff'd in the Steams of it, he was ſeis'd with a giddineſs in his Head and fainting fits, his whole Face alſo ſwelling, though by taking of Antidotes he eſcap'd the danger.

* Sennert. *Lib. 6. part. 6. cap. 2.*

Divers other Examples we have met with in the writings of Phyſicians, which I forbear to add to theſe, becauſe, I confeſs, I very much doubt the Truth of them, though the deliverers of ſome of them be men of Note. But the probability of moſt of the things already cited out of credible Authors may be ſtrengthned by what I ſhall now ſubjoyn, as a further proof of the diſtinct Nature of *Effluvia*; of which it will be a very conſiderable Proof, if Medicines, which are of a milder and more

more familiar nature and operation than Poysons, shall yet be able in some cases to retain, in their invisible Particles swimming in the Air, the same, (though not so great) power of Purging, which is known to belong to them when their gross Body is taken in at the Mouth. Of this I have elsewhere, on another occasion, given some Examples. To which I shall now add, that I know a Doctor of Physick, that is usually Purg'd by the Odours or Exhalations of a certain Electuary, whose Cathartick Operation, when it is taken in substance, is wont to be but languid. And another Doctor of my acquaintance, causing good store of the root of black Hellebore to be long pounded in a mortar, most of those, that were in the room, and especially the party that pounded it, were thereby purg'd, and some of them strongly enough. And the Learned *Sennertus* somewhere affirms, that some will be purg'd by the very Odour of *Colocynthis*. And 'tis not to be pass'd by unre-

unregarded, that in the caſes I have alledg'd, Exhalations, that are endow'd with Occult Qualities, (for thoſe of Cathartick Medicines are reckon'd among ſuch) aſcend into the Air without being forc'd from the Bodies they belong'd to by an External heat.

And if I would in this place alledge Examples of the Operations of ſuch *Effluvia*, as do not paſs into the Air, but yet operate only by the contact of the External parts of the Body, I could give Inſtances, not only of the *Purgative*, but the *Emetick* Qualities of ſome Medicines exerted without their being taken in at the Mouth, or injected with Inſtruments.

There are alſo other ſorts of Examples than thoſe hitherto mentioned, that argue a Determinate Nature in the Effluxions of ſome Bodies emitted into the Air. Approv'd Writers tell us, that the Shadow of a Walnut-tree with the Leaves on it is very hurtful to the Head; and ſome Inſtances they give us of great miſchief it has

ſome-

ſometimes done. And though the Shadow, as ſuch, is not likely to be guilty of ſuch bad Effects; yet the *Effluvia* of the neighbouring Plant may be noxious enough to the Head. For I, that was not at all prepoſſeſs'd with an opinion that it was ſo, and therefore without ſcruple reſorted to the Shade of Walnut trees in a hot Countrey, was by experience forc'd to think it might give others the Head-ach, ſince it did to me, who, thanks be to God, both was, and am ſtill very little ſubject to that diſtemper. And this brings into my mind an Obſervation that I have met with among ſome ingenious Travellers into the *Weſt-Indies*, who obſerve in general, and of late a Countrey-man of our own affirms it in particular, of the poyſonous *Manchinello-tree*, that Birds will not only forbear to eat of the Fruit of venemous Plants, but, as to ſome of them, will not ſo much as light on the Trees: Which I therefore mention, becauſe probably Nature inſtructs them to avoid ſuch

ſuch Trees by ſome noxious Smell, or other Emanation, that offends the approaching Birds. And I remember, that ſome of our Navigators give it for a Rule to thoſe that happen to land in unknown Iſlands or Coaſts, that they may venture to eat of thoſe parts of Fruits which they can perceive, the Birds, like kind Taſters, to have been pecking at before.

Nicolaus Florentinus (cited by *Sennertus*) tells us of a certain *Lombard*, that having in a Houſe, that he nam'd, at *Florence*, burn'd a great black Spider at the flame of a Candle, ſo unwarily, that he drew in the Steams of it at his Noſtrils, preſently began to be much diſorder'd and fell into a fainting fit, and for the whole night had his Heart much diſaffected, his Pulſe being ſo weak, that one could ſcarce perceive he had any; though afterwards he was cured by Treacle, Diamoſc, and the powder of Zedoary mixt together.

And I remember, that being ſome years ago in *Ireland*, I gather'd a

certain Plant (peculiar to ſome parts of that Countrey) which the Natives call *Maccu-buy*, becauſe of ſtrange Traditions that go about it; the chief of which I found by tryal not to be true: But yet being ſatisfied, that its Operations were odd and violent enough, I was willing to gratifie the chief Phyſician of the Countrey, who was deſirous I ſhould propoſe to him ſome wayes of correcting it; and whilſt I was ſpeaking of one that required the pounding of it, he told me on that occaſion, that intending to make an extract of it with Vinegar, he caus'd his man to beat it well in a Mortar, which the man ſoon repented he had begun to do: And the Doctor himſelf, though at a pretty diſtance off, was ſo wrought upon by the Corpuſcles that iſſued out into the Air, that his Head, and particularly his Face, ſwell'd to an enormous and diſfiguring bulk, and continued tumid for no inconſiderable time after.

I have not leiſure to ſubjoyn many more

more Inſtances to ſhew the Determinate Nature of Effluviums, ſmall enough to wander through the Air; nor perhaps will it be neceſſary, if you pleaſe but to conſider theſe two things. The *firſt*, that many odoriferous Bodies, as Amber, Musk, Civet, *&c.* as they will, by the adheſion of their whole ſubſtance, perfume Skins, Linnen, *&c.* ſo they will in time perfume ſome Bodies diſpoſed to admit their action, though kept at a diſtance from them. And the *other* is, that in Peſtilential Feavers and divers other Contagious ſickneſſes, as the Plague, Small-pox, or Meaſels, the ſame determinate Diſeaſe is communicable to ſound perſons, not only by the immediate contact of the infected party; but without it, by the Contagious Steams that exhale from his Body into the Air. And having ſaid this and deſir'd you to reflect upon it, I ſhall conclude this *Chapter* with an Experiment, that poſſibly will not a little confirm a great part of it.

Conſidering then with my ſelf, how I might beſt deviſe a way of ſhewing to the very Eye, That *Effluvia* elevated without the help of Heat, and wandering in the Air, may *both* retain their own Nature, *and* upon determinate Bodies produce Effects, that a Vulgar Philoſopher would aſcribe to Occult Qualities: I remember'd, that I had found by tryals (made to other purpoſes) that Volatile and Sulphureous Salts would ſo work upon ſome Acid ones ſublim'd with Mercury, as to produce an odd diverſity of Colours, but chiefly an Inky one; on which account I judg'd it likely that my aim would by anſwer'd by the following Experiment.

I took an Ounce, or better, of ſuch a Volatile Tincture of Sulphur, as I have elſewhere* taught you to make of Quick-lime, Sulphur and *Sal Armoniack*, and ſtop'd it up in a Vial capable

* *The Liquor here mention'd is, for the main, the ſame with that deſcrib'd by the Author in his Book of* Colours, *Experiment the*

capable of containing at leaſt twice as much; then taking a Paper whereon ſomething had been written with inviſible Ink, I laid it down ſix Inches off of the Vial, which, being unſtop'd, began, upon the acceſs of the Fire, to emit white Fumes into it, and by theſe, what was written upon the Paper, notwithſtanding its diſtance from the Liquor, quickly became very legible, though not quite ſo ſuddenly, as if a Paper, written with the ſame clear Liquor, were held at the like diſtance directly over the orifice of the Vial. And having caus'd ſeveral pieces of clean Paper to be written on, with a new Pen dip'd in the clear Solution of Sublimate made in Water, 'twas pleaſant to ſee, how divers of the Letters of ſeveral of theſe Papers, being plac'd within ſome convenient diſtance of the Vial, would be made plainly legible, and ſome of them more, ſome leſs blackiſh, according to their diſtances from the ſmoaking Liquor, and other Circumſtances. But 'twas

more ſurprizing to ſee, that when I held or laid ſome of theſe Papers, though with the written ſide upwards, juſt upon or over the orifice of the Vial, though the contained Liquor did not by ſome Inches reach ſo high, yet the latent Letters would become not only legible but conſpicuous in about a quarter of a Minute of an Hour (meaſur'd by a good Watch fit for the purpoſe, as more than one tryal aſſur'd me.) And as it may be obſerv'd, that in ſome Circumſtances the ſmoaking Liquor and the Solution of Sublimate will make an odd Precipitate almoſt of a ſilveriſh colour, ſo in one or two of our Tryals we found a like colour produc'd, by the Steams of that Liquor, in ſome of the colourleſs Ink. Nor is it ſo neceſſary to employ a viſibly ſmoaking Liquor for the denigrating of inviſible Ink at a diſtance. For I have, to that purpoſe, with good ſucceſs, though not equal to that I have recited, employ'd a couple of Liquors, wherein there was neither Sulphur,

nor

nor *Sal Armoniack*, nor Sublimate. What other Tryals I made with our Volatile Tincture of Sulphur, 'tis not neceſſary here to relate; only one Experiment, which you will poſſibly think odd enough, I ſhall not omit; becauſe it will not only confirm the precedent Tryals, but alſo much of the foregoing Eſſay, by ſhewing the great Subtilty and penetrating power of Effluviums that ſeem rather to iſſue out very faintly, than to be darted out with any briskneſs.

Cauſing then ſomething to be written with diſſolv'd Sublimate upon a piece of Paper, we folded the Paper with the written ſide inwards, and then inclos'd this in the midſt of ſix ſheets of Paper, laid one upon another, not plac'd one within another, and folded up in the form of an ordinary Letter or packet to be ſeal'd, that, the edges of the encloſing Paper being inſerted one within the other, the Fumes might not get into this written Paper but by penetrating through the Leaves themſelves: This

done, that ſide of the Packet, on which there was no commiſſure, and on which, were it to be ſent away, the Superſcription ſhould be written, was laid upon the orifice of the Vial, which (as was before intimated) was ſome Inches higher than the ſurface of the Liquor, and left there about ten Minutes; after which taking off the folded Papers, and opening them, we found, that the Steams had pervaded all the Leaves, in which the written Paper had been enclos'd. For, though the Leaves did not appear ſtain'd or alter'd, yet the formerly latent Characters appear'd conſpicuous. I have not time to diſcourſe, whether and how far this Experiment may aſſiſt us to explain ſome odd Effects of Thunder, or of that ſtrange *Phenomenon*, (glanc'd at in the foregoing Chapter,) which is ſaid to have happen'd lately in the Kingdom of *Naples* after the great Eruption of *Veſuvius*, which is ſaid to have been follow'd by the appearing of the Croſſes formerly mention'd, ſome of which

which have been found on the innermoſt parts of Linnen, that had been carefully folded up. But of theſe and the like things, I ſay, I have now no time to diſcourſe, whether any thing derivable from our Experiment may be pertinently apply'd to their Explication. For which reaſon I ſhall add no more than that afterwards for further tryal we took a printed Book, that chanc'd to be at hand, and which we judg'd the fitteſt for our purpoſe, becauſe the leaves being broad they might the better preſerve a ſmall Paper to be plac'd in the mid'ſt of them from being acceſſible to the Exhalations ſidewiſe, and having put the deſign'd Paper into this Book, and held it to the orifice of the Vial, though there were no leſs than twelve leaves between them; yet thoſe Letters, that happen'd to be the moſt rightly plac'd, were made inky in the ſhort ſpace of three Minutes at the utmoſt; though this Liquor had been ſo long kept and ſo often unſtop'd to try Concluſions with it,

that

that it had probably loſt a good part of the moſt ſpirituous and piercing Particles.

NEW

NEW EXPERIMENTS,

To make the PARTS

OF

FIRE and *FLAME*

Stable & Ponderable.

BY

The Honorable Robert Boyle.

LONDON:

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A PREFACE; SHEWING The Motive, Deſign, and Parts of the enſuing Tract.

THE Inducements which put me upon the Attempt, expreſs'd in the Title of this Eſſay, *were chiefly theſe:*

First, *I conſider'd, that the Inter-ſtellar part of the Univerſe, conſiſting of Air and* Æther, *or Fluids analogous to one of them, is diaphanous; and that the* Æther *is, as it were, a vaſt Ocean, wherein the Luminous globes, that here and there like Fiſhes* ſwim *by their own motion, or like Bodies in Whirlpools are* carried about *by the Ambient, are but very thinly diſpers'd, and conſequently that the proportion, that the Fixt Stars and*

and Planetary Bodies bear to the diaphanous part of the World, is exceeding small and scarce considerable; though we should admit the Sun and Fixt Stars to be Opacous Bodies upon the account of their terminating our sight: Which diffident Expression I employ, because I have elsewhere shewn by two or three Experiments, purposely devised, that a Body may appear opacous to our Eyes, and yet allow free passage to the beams of Light.

I further consider'd, that there being so vast a disproportion between the diaphanous part of the World and the Globes, about which 'tis every way diffused, and with which it is sometimes in great portions mingled, as in the Water, which together with the Earth makes up the Globe we inhabit; and the nature of Diaphanous Bodies being such, that, when the Sun or any other Luminous Body illustrates them, that which we call Light does so penetrate and mix it self per minima with them, that there is no sensible part of the transparent Body unenlightned; I thought it worth the enquiry, whether a thing, so vastly diffused

as

as Light is were ſome thing Corporeal or not? And whether, in caſe it be, it may be ſubjected to ſome other of our Senſes beſides our Sight, *whereby we may examine, whether it hath any affinity with other Corporeal beings, that we are acquainted with here below?*

I did not all this while forget, that the Peripateticks *make Light a meer Quality, and that* Carteſius *ingeniouſly endeavours to explicate it by a modification of Motion in an Ætherial matter: But I remember'd too, that the* Atomiſts *of old, and of late the Learned* Gaſſendus, *and many other Philoſophers aſſert Light to be Corporeal; and that ſome Years ſince, though I declined to paſs my Judgement about the Queſtion, yet I had employ'd Arguments, that appear'd plauſible enough to ſhew, That 'twas not abſurd to ſuppoſe, that the Sun, which is the Fixt Star moſt known to us, might be a Fiery Body. And therefore doubting, whether the Corporeity of Light would be in haſte Determined by meer Ratiocinations, I thought it very well worth the endeavouring to try whether I could do any thing*

thing towards clearing the diſpute of it by Experiments; eſpecially being perſwaded, that, though ſuch an attempt ſhould be ineffectual, it would but leave the controverſie in its former ſtate, without prejudicing either of the contending Hypotheſes; *and yet, if it ſhould prove ſucceſsful, the conſequences of it would be very great and uſeful towards the explicating of divers* Phænomena *in divers parts of Natural Philoſophy, as in Chymiſtry,* Botanicks, *and (if there be any ſuch) the allowable part of Aſtrologie. (Nor perhaps would it be impoſſible by the help of ſlight Theorical alterations, to reconcile the Experiments, I deſign'd, to either of the above-mention'd* Hypotheſes, *and ſo, as to the Explication of Light, to one another.)*

To compaſs then, what I aim'd at, I thought, 'twas fit in the firſt place to try, what I could do by the Union of the Sun-beams, they being on all hands confeſs'd to be Portions (as I may ſo ſpeak) of true and Celeſtial Light: *And then, I thought fit to try, what could be obtain'd from* Flame; *not only becauſe* that

that is acknowledg'd to be a Luminary, but because I hoped, the difficulties, I foresaw in the other Tryals, might be in some measure avoided in those made with Flame; and if both sorts of them should succeed, the later and former would serve to confirm each other. According to the Method I proposed of handling these two Subjects, I should begin with some account of what I attempted to perform in the Sun-beams. But the truth is, that when I chanc'd to fall upon the Enquiry that occasion'd this Paper, besides that the time of the Year it self was not over-favourable, the Weather proved so extraordinary dark and unseasonable that it was wonder'd at; so that, though I was furnish'd with good Burning-glasses, and did several times begin to make tryals upon divers Bodies, as Lead, Quicksilver, Antimony, &c. yet the frequent interposition of Clouds and Mists did so disfavour my Attempts, that, however they were not all alike defeated, yet I could not prosecute the greatest part of them to my own satisfaction. And therefore being unwilling to build on them as yet;

I ſhall reſerve an account of them for another opportunity; and now proceed to the mention of that ſort of Experiments which depending leſs on Caſualties, 'twas more in my power to bring to an Iſſue.

I know I might have ſaved both you and my ſelf ſome time and pains by omitting ſeveral of theſe Tryals, and by a more compendious way of delivering the reſt. But I rather choſe the courſe I have taken; partly *becauſe the Novelty and Improbabilities of the Truth I deliver ſeems to require, that it be made out by a good number of Tryals;* partly *becauſe I thought it might not be altogether uſeleſs to you and your Friends, to ſee upon what Inducements the ſeveral ſteps were made in this Inquiry;* partly *becauſe I was willing to contribute ſomething towards the Hiſtory that now perhaps will be thought fit to be made of the Increment or Decrement that particular Bodies may receive by being expoſed to the Fire; and* partly *(in fine) becauſe the Incongruity of the Doctrine here aſſerted to the Opinions of the Schools, and the general Prepoſſeſſions*

of

of Mankind, made me think it fit by a considerable Variety, as well as number, of Experiments to obviate, as far as may be, the differing Objections and Evasions wherewith a Truth so paradoxical may expect to be encountred.

New EXPERIMENTS,

To make

FIRE and FLAME PONDERABLE.

THough there be among the following Tryals a Diverſity that invites me, as to rank them into four or five differing ſorts, ſo to aſſign them as many diſtinct Sections; yet for the conveniency of making the References, there will be occaſion to make betwixt them, I ſhall wave the Diſtinction, and ſet them down in one continued *Series*.

And becauſe I am willing to comply with my haſt, as well as to deal frankly and without Ceremony with you, I ſhall venture to ſubjoyn the naked Tranſcripts of my Experiments, as I had in an artleſs manner

ſet them down with many others for my own remembrance among my *Adverſaria*; without ſo much as retrenching ſome Circumſtances that relate leſs to my preſent Argument, than to ſome other purpoſes.

I ſhall then begin with the mention of a couple of Experiments; which though they might conveniently enough be referr'd to another Paper; yet I ſhall here ſet them down, becauſe it ſeems very proper to endeavour to ſhew in the firſt place, that Flame it-ſelf may be as 'twere incorporated with cloſe and ſolid Bodies ſo as to increaſe their bulk and weight.

Tryals

Tryals of the First sort.

EXPERIMENT I.

A Piece of Copper-plate not near so thick as a Half-crown, and weighing two Drachmes and twenty-five Grains, was so plac'd with its broad part Horizontal, in a Crucible, whose bottom had a little hole in it, for Fumes to get out at, that it could not be removed from its Position, nor be easily made to drop down or lose its Level to the Horizon, though the Crucible were turned upside down: Then about an Ounce and half of common Sulphur being put into a taller and broader Crucible, that, wherein the Copper stuck, was inverted into the orifice of it, that the Sulphur being kindled, the flame, but not the melted Brimstone in substance, might reach the Plate, and have some vent beyond it at the above-mentioned hole.

This Brimſtone burn'd about two Hours, in which time it ſeem'd all to have been reſolved into Flame, no flowers of Sulphur appearing to have ſublimed into the inſide of the upper Crucible; and though the Copper-plate were at a conſiderable diſtance from the ignited Sulphur, yet the Flame ſeem'd to have really penetrated it, and to have made it viſibly ſwell or grow thicker; which appear'd to be done by a real acceſſion of ſubſtance: ſince, after we had wip'd off ſome little adhering *ſordes*, and with them divers particles of Copper that ſtuck cloſe to them, the Plate was found to weigh near two and thirty Grains more than at firſt, and conſequently to have increaſed its former weight by above a fifth part.]

EXPER. II.

[Having, by refining one Ounce of ſterling Silver with Salt-peter, according to our way reduc'd it to ſeven Drachms or ſomewhat leſs; we

we took a piece of the thus purified Silver, that weighed one Drachm wanting two Grains, and having order'd it as the Copper-plate had been in the former Experiment, after the flame of above one Ounce and a quarter of Sulphur, (that Quantity chancing to be ſuitable to the Capacity of the Crucible) had for about an Hour and a half beat upon it, the Silver-plate ſeem'd to the Eye ſomewhat ſwell'd, and the lower ſurface of it, that was next the flame, was brought to a great ſmoothneſs, the weight being increas'd to one Drachm five Grains and three quarters; which increaſe of weight falling ſo ſhort of that which was gain'd by the Copper, I leave it to you to conſider, *whether* the difference may be attributed to the cloſeneſs and compactneſs of the Silver, argued by its being heavier in *ſpecie* than Copper; *or* to the greater congruity of the pores of Copper to be wrought on by the fiery *Menſtruum*; *or* to ſome other cauſe.]

If

If you ſhould here ask me, by what Rational inducements I could be led to entertain ſo extravagant an expectation, as that ſuch a light and ſubtile Body as Flame ſhould be able to give an augmentation of weight to ſuch ponderous Bodies as Minerals and Metals; I ſhall now, to avoid making anticipations here, or needleſs repetitions hereafter, return you only this Anſwer: That the expectation you wonder at may juſtly be entertained upon the ſame or ſuch like inducements, as you may eaſily diſcover in another Paper, entitled *Corollarium Paradoxum*. For, ſuppoſing upon the grounds there laid, that Flame may act upon ſome Bodies as a *Menſtruum*, it ſeems no way incredible, that, as almoſt all other *Menſtruums*, ſo Flame ſhould have ſome of its own Particles united with thoſe of the Bodies expos'd to its action: And the generality of thoſe Particles being, (as 'tis ſhewn in the *Paradox* about the Fewel of Flames,) either Saline, or of ſome

ſuch

ſuch piercing and Terreſtrial nature, 'tis no wonder, that being wedg'd into the Pores, or being brought to adhere very faſt to the little Parts of the Bodies expos'd to their action, the acceſſion of ſo many little Bodies, that want not gravity, ſhould, becauſe of their multitude, be conſiderable upon a Ballance, whereon one or two, or but few of theſe Corpuſcles would have no viſible Effect.

I could here, if it were expedient, mention ſome odd ſcruples about the preceding Experiments, and ſome alſo of the ſubſequent; but, leſt you ſhould, with ſome other of my Friends, upbraid me with being too jealous and Sceptical, I will not trouble you with them; but proceed to the next ſort of Tryals, wherein, though the matter were not always manifeſtly beaten on by a *ſhining* Flame, yet it was wrought on by that, which would be called Flame by thoſe who take not that *word* ſtrictly; but in a latitude, and which this Igneous ſubſtance may more properly be ſtiled, than

than it can be call'd common Fire, this being visibly harbour'd in burning Coals or other gross materials, from which our Metals were senc'd. And I have elsewhere shewn by experiment, that *Visibility* is not in all cases necessary to Actual Flame, particularly when the Eye receives a predominant impression from another Light.

Tryals of the Second sort.

EXPER. III.

INto a Crucible, whose sides had been purposely taken down to make it very shallow, was put one Ounce of Copper-plates, and this being put into our Cupelling-furnace, and kept there two Hours, and then being taken out we weighed the Copper (which had not been melted) having first blown off all the ashes, and we found it to weigh one Ounce and thirty Grains.

EXPER.

EXPER. IV.

[Supposing that Copper, being reduc'd to filings, and thereby gaining more of Superficies in proportion to its bulk, would be more expos'd to the Action of the Fire, than when 'tis in plates as it was formerly; we took one Ounce of that Metal in filings, and putting them upon a very shallow Crucible, and under a Muffler, we kept them there about three Hours, (whilst other things that required so long a time were Cupelling;) and afterwards taking them off, we found them of a very dark colour, not melted but caked together in one Lump, and increas'd in weight (the ashes and dust being blown off) no less than about forty-nine Grains. Part of which increment, above that obtained by the Copper-plates in the former Experiment, may not improbably be due to the longer time that in this Experiment the fil'd Copper was kept in the Fire.]

EXPER.

EXPER. V.

[Being willing to see, whether *calcin'd Harts-horn*, that I did not find ease to be wrought on by corrosive *Menstruums*, would retain any thing of the Flame or Fire to which it should be expos'd; we weigh'd out one Ounce of small Lumps of Harts-horn, that had been burnt till they appear'd white, and having put them into a Crucible, and kept them in a Cupelling-furnace for two Hours, whilst some Metals were driving off there by the violence of the Fire, we found, that when they were taken out, they had lost six or seven Grains of their former weight; perhaps *either* because, notwithstanding the external whiteness of the Lumps, the internal Parts of some of them might not be so exquisitely calcin'd, but retain some Oleaginous or other Volatile Substance; *or*, because, having omitted to ignite them well before they were weigh'd, they may have since

ſince their firſt Calcination imbib'd ſome moiſt Particles of the Air. Which conjecture ſeem'd the likelier, becauſe, having kept them a while in the Scales they were weigh'd in, they did within two or three Hours make it ſomewhat preponderate. On which occaſion I ſhall add, that, at the ſame time, with the Harts-horn we put in one Ounce of well-heated Brick, and kept that likewiſe in the Furnace for above two Hours; at the end of which weighing it whilſt it continued hot, we did not find it to have either ſenſibly got or loſt; but, ſome time after, it ſeem'd upon the Ballance to have imbib'd ſome, though but very little, moiſture from the Air.]

EXPER. VI.

[Upon a good Cupel we put one Ounce of *Engliſh* Tin of the better ſort, and having plac'd it in the Furnace under a Muffler, though it preſently melted, yet it did not forſake

its

its place, but remain'd upon the concave ſurface of the Cupel, till at the end of about two Hours it appear'd to have been well calcin'd, and then being taken out and weighed by it ſelf, the Ounce of Metal was found to have gained no leſs than a Drachm.]

EXPER. VII.

[An Ounce of Lead was put upon the Cupel, made of calcin'd Hartshorn, and placed under the Muffler after that the Cupel was firſt made hot and then weighed. This Lead did not enter into the Cupel, but was turn'd into a pretty kind of Litharge on the top of it, and broke the Cupel, whereby ſome part of the Cupel was loſt in the Furnace, and yet the reſt, together with the Litharge, weigh'd ſeven Grains more than the Ounce of Lead and the heated Cupel did when they were put in.]

But becauſe, though this tryal ſhew'd that ſome weight was gain'd either by the Metal or Cupel, or both; yet

yet it did not by this appear, what either of them acquir'd; it ſeem'd fit to ſubjoyn a further tryal.

EXPER. VIII.

[We took a Cupel about two Ounces in weight, made of about ten parts of Bone-aſhes, and one of Charcoal-aſhes, made up together with Ale. This was by it ſelf put in a Cupelling-furnace, under a Muffler; and the Laborant, well vers'd in weighing, was order'd to take it out when 'twas throughly and highly heated, and to weigh it whilſt 'twas in that condition (I being then preſent:) This being done, 'twas forthwith plac'd again under the Muffler, where ſome Metalline Bodies were Cupelling, and kept there for about two Hours; at the end of which time 'twas taken out red-hot, and preſently put into the ſame Ballance, as before, which was already faſtned to a Gibbet; where having caus'd the adhering aſhes to be blown off,

I found, that whereas, when 'twas firſt taken from under the Muffler, we had but two Ounces and two Grains, now the ſame weight being put into the oppoſite Scale, it had gain'd very near one and twenty Grains. And here note, that 'twas not without ſome cauſe, that I was careful to have the Cupel weighed red-hot. For I had a ſuſpition, that, notwithſtanding the dryneſs of the Bone, it might receive ſome little alteration of weight by imbibing ſome little Particles wandering in the Air; which ſuſpition the event juſtified. For leaving the Cupel counterpois'd to cool in the Ballance, in a ſhort time it began ſenſibly to preponderate; and ſuffering it to continue there nine or ten hours, till we had occaſion to uſe the Ballance, I found it at the end of that time to be about three Grains heavier than before.]

This was not the only tryal we made about the augmenting the weight of Cupels; but this being the faireſt, and exempt from thoſe miſ-

miſchances; from which the other were not altogether free; I ſhall content my ſelf to have ſet down this: In the mention of which I thought fit to take notice of the increaſe of the weight of the Cupel after it had layn in the Scales, and alſo that we weighed it at firſt whilſt it was throughly hot, becauſe thoſe Circumſtances, as not being ſuſpected, may eaſily be left unthought on, even by skilful Experimenters; and yet the weighing of the Cupel, when it had been well neal'd, and the not weighing it ſoon enough after 'tis taken from the Fire, may keep thoſe, that ſhall reiterate this Experiment, from making it cautiouſly and accurately enough. For if the former Circumſtance be omitted, that which the Cupel may ſeem to have loſt of its ſubſtance, was nothing but the adventitious moiſture of the Air; and if the later Circumſtance be neglected, the weight, it may ſeem to have gain'd from the Fire, was *indeed* due to the wateriſh Particles of the Air. I could

wiſh alſo, that tryal were made, whether the ſucceſs would be the ſame in Cupels made in differing ſorts of Bone-aſhes, and other materials, wont to be employed for that purpoſe. For That I had not opportunity to do.

EXPER. IX.

Iron being a Metal, that experience had inform'd me will more eaſily be wrought on by Fluids that have Particles of a Saline nature in them, than is commonly believed; 'twas not unreaſonable to expect, that Flame would have a greater Operation on it, (eſpecially if it were before-hand reduc'd to ſmall Parts) than on any of the Bodies hitherto deſcrib'd. Which ſuppoſition will be confirm'd by the ſhort enſuing Note.

[Four Drachms of filings of Steel being kept two Hours on a Cupel under a Muffler, acquir'd one Drachm ſix Grains and a quarter increaſe of weight.]

EXPER.

EXPER. X.

[A piece of Silver, refin'd in our own Laboratory, being put upon a Cupel under a Muffler, and kept there for an hour and half, whilſt other things were refining, was taken out and weigh'd again, and, whereas before it weighed three Drachms, thirty-two Grains and a quarter, it now weighed in the ſame Scales three Drachms, thirty-four Grains and a half, or but little leſs.]

Finding this Memorial among divers others about the Weight of Bodies, expos'd to the Fire, I thought it not amiſs to annex it in this place; though finding it to be but ſingle, I would not have it to be rely'd on till further tryal have been made to diſcover, whether it was more than a caſual and anomalous Experiment; and if the Silver had not been refin'd, I ſhould have ſuſpected, that the Copper, that was blended with it, as 'tis uſually blended with common

Silver, might have occaſioned the increaſe of weight.

(Poſtcript.)

Since the foregoing Experiment was firſt ſet down, meeting with an opportunity to reiterate the tryal once more, we did it with half an Ounce of filings of Silver, well re-fin'd with Lead in our own Laboratory, and kept it about three hours upon the Cupel; after the end of which time taking it out, we found it to be of a leſs pleaſant colour than it was of before, and melted (though not ſo perfectly) into a Lump, which weigh'd four Drachms and ſix Grains; and yet, the ſucceſs being ſo odd, and, if it prove conſtant, of ſuch moment, I could wiſh the tryal were further repeated in differing quantities of the Metal.

EXPER. XI.

[We took a Drachm of filings of *Zinc* or *Spelter*, and having put it upon

upon a Cupel under a Muffler, we kept it there in a Cupelling-fire about three Hours, (having occaſion to continue the Cupellation ſo long for other tryals;) then taking it off the Cupel, we found it to be caked into a brittle and dark-colour'd Lump, which look'd as if the filings had been calcin'd. This being weigh'd in the ſame Scales gain'd full ſix Grains, and ſo a tenth part of its firſt weight.]

EXPER. XII.

Among our various tryals upon common Metals, we thought fit to make one or two upon a Metal brought us from the *Eaſt-Indies*, and there call'd *Tutenâg*, which name being unknown to our *European* Chymiſts, I have elſewhere endeavoured to give ſome account of the Metal it ſelf; whence I ſhall borrow the enſuing Note, as directly belonging to our preſent purpoſe.

[Two Drachms of filings of *Tute-*

nâg being put upon a Cupel, and kept under the Muffler for about two hours, the filings were not melted into a Lump of Metal, but look'd as if Ceruſs and *Minium* being pouder'd had been mingled together; ſome of the parts appearing diſtinctly white, and others red: The *Calx* being put into the Ballance appear'd to have gained twenty-eight Grains and a quarter. Another time the Experiment being reiterated with the like Circumſtances, we found, that two Drachms of the filed *Tutenâg* gained the like increaſe of weight, abating leſs than one Grain.]

So that this *Indian* Metal ſeems to have gain'd more in the fire, in proportion to its weight, than any we have hitherto made tryal of.

EXPER. XIII.

[Being deſirous to confirm by a clear Experiment, what I elſewhere deliver contrary to the vulgar Opinion of thoſe that believe, that in all Cupellations almoſt all the Lead that

that is employ'd about them, does, together with the baſer Metals that are to be purg'd off from the Silver or Gold, fly away in Smoak, as indeed in ſome ſort of Cupellations a good proportion may be blown off that way: We took two Ounces of good Lead and one Drachm of filings of Copper, and having caus'd a Cupel to be ignited, and nimbly taken out of the Furnace, and weighed, whilſt 'twas very hot, 'twas preſently put back, together with the two Metals laid on it, into the Cupelling-furnace, where having been kept for about two hours, it was taken out again, and 'twas found, according to what (as I elſewhere * note) uſes to happen in ſuch Circumſtances, to have nothing on the ſurface of it worth weighing diſtinctly in the Scales, in which the Cupel with what was ſunk into it amounted to four Ounces three Drachms and eleven Grains, which wanted but nine Grains of the whole weight of the

* *Eſſay the ſixth of the* Uſeful. *of* Nat. Philoſ.

the Cupel and the two Metals, when they were all three together committed to the Fire.] So that, though we make a liberal allowance for the increment of weight that may with any probability be ſuppoſed to have been attained by the Cupel and what was put upon it, yet it will eaſily be granted, that very much the greater part of the Metals was not driven off in Fumes, but enter'd into the Subſtance of the Cupel.

Tryals of the Third ſort.

AFter having ſhewn that either Flame or the Analogous Effluxions of the Fire will be, what Chymiſts would call, Corporified with Metals and Minerals expoſed *naked* to its action; I thought it would be a deſirable thing to diſcover, whether this Flame or igneous Fluid were ſubtile enough to exerciſe any ſuch Operation upon the Light Bodies ſhelter'd from its immediate

contact

contact by being included in close Vessels; but it being very difficult to expose Bodies in Glasses to such vehement Fires without breaking or melting the Glass, and thereby losing the Experiment; I thought fit, first to employ Crucibles carefully luted together, that nothing might visibly get in or out, and of that attempt I find among my Notes the following Account.

EXPER. XIV.

[We took an Ounce of Steel freshly filed from a Lump of that Metal, that the filings might not be rusty, and having included them betwixt two Crucibles, as formerly, kept them for two hours in a strong Fire, and suffer'd them to continue there till the Fire went out; the Crucibles being unluted, the filings appear'd hard caked together, and had acquir'd a dark colour somewhat between black and blew, and were increas'd five Grains in weight.]

The

The foregoing Experiment being the first I mention of this kind, 'twill not be amiss to confirm it by annexing the following Memorial.

[An Ounce of filings of Steel being put between the Crucibles luted together, after they had been kept about an hour and half in the fire, were taken out, and being weigh'd, were found to have gained six Grains.]

EXPER. XV.

[Two Ounces of Copper-plate were put into a new Crucible, over which a lesser was whelmed, and the commissures were closed with lute, that nothing might fall in. After the same manner two Ounces of Tin were included betwixt Crucibles, and also two Ounces of Lead; these being put into the Cupelling-furnace were kept in a strong Fire about an hour and a half, while something else was trying there. And then being taken out, the event was, that the Copper-plates, though they stuck

ſtuck together, were not quite melted, and ſeem'd ſome of them to have acquir'd ſcales like Copper put into a naked Fire, and the two Ounces had gain'd eight Grains in weight. The Lead had broke through the bottom of the Crucible, and thereby hinder'd the deſign'd Obſervation. The Tin acquir'd ſix Grains in weight, and was in part brought to a pure white *Calx*, but much more of it was melted into a Lump of a fine yellow colour, almoſt like Gold, but deeper.] The proſecution of this tryal as to the Copper-plates you will meet with in *Experim.* XXI. to which I therefore referr you.

N. B. Becauſe Lead in Cupellation enters the Cupel, we were willing to try, if we could ſo far hinder it from doing ſo, as to make ſome eſtimate what change of Weight the Operation of the Fire would make in it: And therefore being able already to make a near gueſs, how much a quantity of Tin may gain by being calcined on a Cupel, and remem-

remembring alſo from ſome of my former tryals the indiſpoſition which Tin gives Lead to Cupellation, we mixed a Drachm of Tin with two Ounces of Lead, and expoſing the mixture (in a Cupel) to the Fire under a Muffler, we firſt brought it to fuſion, and then it ſeem'd at the top dry and ſwell'd and diſcolour'd; notwithſtanding which, having continued the Operation a good while, becauſe of other things that were to be done with the ſame Fire, we were not lucky enough to bring the Experiment to an iſſue worth the relating here, in reference to the ſcope above-propos'd, though in relation to another the ſucceſs was welcome enough.]

EXPER. XVI.

[Suppoſing that if Copper were beaten into thinner plates than thoſe we lately us'd, and kept longer in the fire, this would have a more conſiderable Operation upon them, we took

took one Ounce of very thinly hammer'd pieces of Copper, and putting them betwixt two Crucibles (one whelm'd over another) as in *Experim.* XV. with ſome lute at the corners of the juncture, to keep the fire from coming immediately at the Metal, we kept them in the Cupelling-furnace about three hours, and then disjoyning the Veſſels, we found the Metal covered with a dark and brittle ſubſtance, like that deſcrib'd in the above recited Experiment. Which ſubſtance, when ſcal'd off, diſclos'd a finely colour'd Metal, which, together with theſe burnt ſcales, amounted to one and twenty Grains above the weight that was firſt put in.]

If, when theſe things were doing, I had been furniſhed with a very good Lute, which is no ſuch eaſie thing to procure, as Chymiſts, that have not frequently employed vulgar Lutes, are wont to think; I would have made a tryal of the enſuing Experiment for a good while in the naked Fire, notwithſtanding that

divers

divers Metalline Minerals will ſcarce be brought to fuſion in Glaſſes, eſpecially without ſuch a Fire, whoſe violence makes them break the Veſſels. For I thought, that by making a fit choice of the Metals to be employed, I could prevent that inconvenience: But wanting the Accommodations I deſir'd, and yet preſuming, that in a Sand-furnace I might by degrees adminiſter heat enough to melt ſo fuſible a Metal as fine Tin, and keep it in fuſion; I reſolved to make ſome tryals, firſt upon that, and then upon another Metal. For though I was not ſure of being then able to proſecute the Experiment far enough; yet I hoped, I might at leaſt ſee ſome Effects of my firſt tryal, which would enable me to gueſs, what I was to expect from a complete one.

EXPER. XVII.

[We took then a piece of fine Block-Tin, and in a pair of good Scales weighed out carefully half a Pound

Pound of it; this we put into a choice Glaſs-retort, and kept it for two days or thereabouts in a Sand-furnace, which gave heat enough to keep the Metal in fuſion without cracking the Glaſs. Then taking out the mixture, we carefully weigh'd it in the ſame Scales, and found the ſuperficies a little alter'd (as if it were diſpos'd to calcination) and the weight to be increaſed about two Grains or ſomewhat better.]

EXPER. XVIII.

[The other Experiment, I tryed in Glaſſes, was with Mercury, hoping, that, if I could make a Precipitate *per ſe* in a Hermetically ſeal'd Glaſs, I ſhould by comparing the weight of the Precipitate, and the Quick-ſilver that afforded it, have a clear Experiment to my purpoſe; and I ſhould have no bad one, if I could but make it ſucceed with a Glaſs, though not ſeal'd, yet well ſtop'd; inſtead of thoſe Infernal-glaſſes (as

they call them) which are commonly us'd and wont to be left open (though some ſlightly ſtop them with a little Paper or Cotton.) But though, partly that I might a little diverſifie the Experiment, and make it the more likely to ſucceed in one or other of the Glaſſes, I divided the Mercury and diſtributed it amongſt ſeveral of them, and but a little to each, the ſucceſs did not anſwer expectation, the Hermetically ſeal'd Glaſſes being unluckily broken; and the Precipitation in the others proceeding ſo ſlowly, that I was by a remove oblig'd to leave the tryal imperfect; only I was encouraged, (in caſe of a future opportunity) to renew it another time, by finding that moſt of the Glaſſes, though tall, and ſtop'd with fit Corks, afforded ſome very fair Precipitate, but not enough to anſwer my Deſign.]

Tryals

Tryals of the Fourth ſort.

MOſt of the Experiments hitherto recited, having been made as it were upon the by with others, whoſe exigencies 'twas fit theſe ſhould comply with; very few of the expos'd Bodies were kept in the Cupelling-fire above two hours or thereabouts. Upon which account I thought fit to try, how much ſome Bodies, that had been already expos'd to the Fire, would gain in weight by being *again* expos'd to it; eſpecially conſidering, that moſt calcinable Bodies, (for I affirm it not of *all*) which yield rather *calces* than aſhes by being without additament reduc'd in the Fire to fine powder, ſeem'd to be by that Operation open'd, or (as a Chymiſt would ſpeak) unlock'd, and therefore probably capable of being further wrought upon and increas'd in weight by ſuch a *Menſtruum* as I ſuppos'd Flame and igneous Ex-

halations to be. And about this Conjecture I ſhall ſubjoyn the enſuing Tryals.

EXPER. XIX.

[One Ounce of *Calx* of Tin, that had been made *per ſe* for an Experiment in our own Laboratory, being put in a new Cupel and kept under the Muffler for about two hours, was taken out hot and put into the Scales, where the powder appear'd to have gain'd in weight one Drachm and thirty-five Grains by the operation of the Fire, which made it alſo look much whiter than it did before, as appeared by comparing it with ſome of the *Calx* that had not been expoſed to the ſecond Fire: No part of the Puttie was, as we could perceive, melted by the vehemence of the Fire, much leſs reduc'd into Metal.]

EXPER.

EXPER. XX.

[Out of a parcel of filings of Steel, that had been before expos'd to the fire, and had its weight thereby increas'd some Grains, not Scruples, we took an Ounce, and having expos'd it at the same time with the *Calx* of Tin, and, for the same time, kept it in the Fire, we took it out at the two hours end, and found the weight to be increas'd two Drachms and two and twenty Grains. The filings were very hard bak'd together, and, the Lump being broken, looked almost like Iron.]

EXPER. XXI.

The following Experiment, though it may seem in one regard but a Continuation of the XVth, yet it has in this something peculiar from all the foregoing, that not only it affords an instance of the increase of Weight obtain'd by a Metal at the second

time of its being expos'd to the fire, but ſhews alſo, that ſuch an increment may be had, though this ſecond ignition be made in *cloſe* Veſſels.

[Some of the Copper mention'd in *Experim.* XV. being accidentally loſt, one Ounce and four Drachms of what remain'd was included betwixt two Crucibles and expos'd to a ſtrong fire for two hours, and ſuffer'd to continue there till the fire went out: When it was taken out, it appear'd to have gain'd ten Grains in weight, and to have upon the ſuperficial parts of the Plates (as we obſerv'd) divers dark colour'd flakes, ſome of which ſtuck to the Metal, but more, upon handling it, fell off.]

And here I ſhall conclude One of the Two Parts of our deſigned Treatiſe: For, though I remember, that theſe were not all the Tryals that were made and ſet down upon the Subject hitherto treated of; yet theſe are the chief, that having eſcaped the miſchances, which befel ſome others,

others, I can meet with among my promiſcuous Memorials, whoſe number, when I drew them together, I could ſcarce increaſe, having by all theſe and other Tryals of differing kinds waſted my Cupels and commodious Glaſſes, where I could not well repair my loſs. Whether I ſhould have been able by Reduction, ſpecifick Gravity, or any other of the ways, which I had in my thoughts, to make any diſcovery of the Nature of the Subſtance that made the Increment of Weight in our United Bodies, the want as well of leiſure, as of accommodations requiſite to go through with ſo difficult a task, keeps me from pretending to know. But theſe three things, I hope, I may have gained by what has been deliver'd. The *Firſt*, That we ſhall henceforth ſee cauſe to proceed more warily in the Experiments we make with Metals in the Fire, eſpecially by Cupellation. The *next*, That it will juſtifie and perhaps procure an eaſier aſſent to ſome paſſages in my

other Writings, that have Relation to the Substance, what-ever it be, that we are speaking of. And the *third*, (which is the principal) That it will probably excite you, and your inquisitive Friends, to exercise their sagacious Curiosity, in discovering what kind of Substance that is, which, though hitherto overseen by Philosophers themselves, and, being a Fluid, far more subtile than visible Liquors, and able to pierce into the Compact and Solid Bodies of Metals, can yet add something to them, that has no despicable Weight upon the Ballance, and is able for a considerable time to continue fixt in the Fire.

Addi-

Additional Experiments,
ABOUT
ARRESTING and WEIGHING
OF
Igneous Corpuſcles.

EXperiments to diſcover the Increaſe in Weight of Bodies, though incloſ'd in Glaſſes, being thoſe that I conſidered as likelieſt to anſwer what I deſign'd in the hitherto proſecuted Attempt, and finding the ſeventeenth *Experiment* as well as the next (try'd upon Mercury) to be very ſlow, and its performance not to be very great, I began to call to mind, what, many years ago, Experience had ſhewn me poſſible to be perform'd, as to the managing Glaſs-veſſels, even without coating them, in a naked Fire, pro-

provided a wary person were constantly employ'd to watch them. And supposing hereupon, that, in no longer time than a Laborant might, without being tir'd, hold out to attend a Glass, a Metal expos'd in it to a naked fire might afford us a much more prosperous tryal than that lately referr'd to, I afterwards resolv'd, when I should be able to procure some Glasses conveniently shap'd, to prosecute my Design; in pursuance of which though I had not any Furnaces fitted for my purpose, I directed a Laborant to make the following Tryals.

EXPER. I.

[We took eight Ounces (*Troy* weight) of Block-Tin, which being cut into bits was put into a good round Vial with a long neck, and then warily held over quick Coals without touching them till it was melted; after which it was kept almost continually shaken, to promote the Calcination, near an hour, the

Metal

Metal being all the while in fuſion, and the Glaſs kept at ſome diſtance from the throughly kindled Coals. The moſt part of this time the orifice of the Vial was cover'd with a Cap of Paper (which ſometimes fell off by moving the Glaſs) to keep the Air and Steams of the Coals from getting into the neck. And at the end of this time, he that held the Glaſs being tir'd, and having his Hand almoſt ſcorch'd, the Vial being remov'd from the fire was broken, that we might take out the Metalline Lump, which had a little darkiſh *Calx* here and there upon the upper ſurface, but much more beneath, where it had been contiguous to the bottom of the Glaſs; then putting all this carefully freed from little fragments of broken Glaſs into the ſame Ballance with the ſelf-ſame counterpoiſe I had us'd before, I found, according to my Expectation, an increaſe of weight, which amounted to eighteen Grains, that the Tin had acquir'd by this Operation.]

EXPER.

EXPER. II.

This done we ſeparated the *Calx* for fear of loſing it, and having melted the Metal in a Crucible, that by pouring it out it might be reduc'd to thin Plates capable of being cut in pieces, and put into ſuch another Vial as the laſt; we weigh'd it again together with the lately reſerv'd *Calx*, but found, that, notwithſtanding all our care, we had loſt three Grains of the eighteen we had gain'd. This done we put the Metal into another Vial. But in regard the neck was ſhorter than that of the former, and could not like it be long held in once Hand; and becauſe alſo I was willing to ſee what Intereſt the ſhaking of melted Tin has in the quickneſs of the Calcination, the Glaſs, which had a ſtopple of Paper put to it to keep out Smoak and Air, was held at ſome diſtance from the Coals, only whilſt the Tin was melting; and then was warily laid

upon

upon them and kept there for two hours; at the end of which, 'twas again taken off, and the Metal weigh'd with the ſame Counterpoiſe and Ballance as formerly; and then it appear'd to amount to eight Ounces twenty-four Grains, and to have much more ſeparable *Calx* than at the firſt time. Nor did I much wonder, that the weight ſhould be increas'd in this laſt Operation but nine Grains in two hours, and in the former twice ſo many in half the time; ſince, during the two hours, the Glaſs was kept in one poſture, whereas in the firſt Operation, it was almoſt perpetually ſhaken all the while 'twas kept in fuſion. And 'tis obſerv'd, that the agitation of melted Minerals will much promote the Effect of the Fire upon them, and conduce to their Calcination.]

EXPER. III.

Though theſe Tryals might well ſatisfie a perſon not very ſcrupulous, yet

yet to convince even thoſe that are ſo, I undertook, in ſpite of the difficulties of the Attempt, to make the Experiment in Glaſſes Hermetically ſeal'd, to prevent all ſuſpition of any acceſſion of Weight accruing to the Metal from any Smoak or Saline Particles getting in at the mouth of the Veſſel. And in proſecution of this deſign I thought upon a way of ſo Hermetically ſealing a Retort, that it might be expos'd to a naked fire without being either crackt or burſt; an Account of which Tryal was thus ſet down.

[Eight Ounces of good Tin carefully weigh'd out was Hermetically ſeal'd up in a new ſmall Retort with a long neck, by which 'twas held in ones Hand, and warily approach'd to a kindled Charcoal-fire, near which the Metal was kept in fuſion, being alſo ever now and then ſhaken for almoſt half an hour, in which time it ſeem'd to have acquir'd on the ſurface ſuch a dark colour as argued a beginning of Calcination, and it both

both emitted Fumes that play'd up and down, and alſo afforded two or three drops of Liquor in the neck of the Retort. The Laborant being not able to hold the Glaſs any longer, 'twas laid on quick Coals, where the Metal continued above a quarter of an hour longer in fuſion; but before the time was come that I intended to ſuffer it to cool in order to the removing it, it ſuddenly broke in a great multitude of pieces, and with a noiſe like the Report of a Gun; but (thanks be to God) it did no harm neither to me nor others that were very near it. In the neck we found ſome drops of a yellowiſh Liquor, which a *Virtuoſo* that taſted it affirm'd to be of an odious but peculiar Sapor; and as for the Smell, I found it to be very ſtinking, and not unlike that of the diſtill'd Oyl of Fiſh.]

But, though our firſt Attempt of this kind had thus miſcarried, we were not thereby diſcourag'd, but in proſecution of the ſame deſign made the enſuing Tryal.

EXPER.

EXPER. IV.

[The Tin which had been before (in the first or some such Experiment) partly calcin'd in a Glass, being melted again in a Crucible, that it might be reduc'd to pieces small enough to be put into another Glass, was put again into the Scales; and the surplusage being laid aside, that there might remain just eight Ounces; these were put into a Bolt-head of white Glass with a neck of about twenty Inches long, which being Hermetically seal'd (after the Glass had been a while kept over the fire, lest that should break by the rarefaction of the Air,) the Metal was kept in fusion for an hour and a quarter, as (being hinder'd by a Company of strangers from being there my self) the Laborant affirm'd. Being unwilling to venture the Glass any longer, it was taken from the fire, and when 'twas grown cold, the seal'd end was broken off; but before I would

I would have the bottom cut out, I obſerv'd, that the upper ſurface of the Metal was very darkly colour'd, and not at all ſmooth, but much and very odly aſperated; and the lower part had between the bottom and the lower part of the Lump a pretty deal of looſe dark-colour'd *Calx*, though the neighbouring ſurface and ſome places of the Lump it ſelf look'd by Candle-light (it being then Night) of a golden Colour. The Lump and *Calx* together were weigh'd in the ſame Scales carefully, and we found the weight to have increas'd twenty-three Grains and better, though all the *Calx*, we could eaſily ſeparate, being weigh'd by it ſelf amounted not to four Scruples or eighty Grains.]

For Confirmation of this Experiment I ſhall ſubjoyn another, wherein but a quarter of ſo much Metal was employed with ſuch ſucceſs as the annexed Memorial declares.

EXPER. V.

[Two Ounces of filings of Tin were carefully weigh'd and put into a little Retort, whose neck was afterwards drawn slenderly out into a very small *Apex*; then the Glass was plac'd on kindled Coals, which drove out fumes at the small orifice of the neck for a pretty while. Afterwards the Glass, being seal'd up at the *Apex*, was kept in the fire above two hours; and then being taken off was broken at the same *Apex*, whereupon I heard the outward Fire rush in, because when the Retort was seal'd the Air within it was highly rarified. Then the body of the Glass being broken, the Tin was taken out, consisting of a Lump, about which there appear'd some gray *Calx* and some very small globuls, which seem'd to have been filings melted into that form. The whole weigh'd two Ounces twelve Grains, the later part of which weight appear'd to have been gain'd by the Operation of the Fire on the Metal.

Metal. In the neck of the Retort, where it was joyn'd to the body, there appear'd a yellowish and clammy substance thinly spread, which smelt almost like the fœtid Oyl of Tartar.]

EXPER. VI.

To vary the foregoing Experiments by making Tryals on a Mineral that is held to be of a very Metalline nature, but is not a true Metal, nor will be brought to fusion by so moderate a Heat as will suffice to melt Tin, and yet has parts less fixt than Tin, as being far more easily sublimable, we thought fit to make the following Experiment.

[We took an Ounce of filings of *Zinke* carefully weigh'd, and having as carefully put them into a round Bolt-glass, we caus'd the neck to be drawn out very slender, and then order'd the Laborant to keep it upon quick Coals for the appointed time. Afterwards returning home, I call'd for the Glass, which he said he had

kept four hours upon the Goals, answering me also, that there did for a great part of the time Smoak appear to ascend from the *Zink* and get out at the unstopt *Apex*. And in effect I observ'd, that the upper part of the Glass was lin'd with *Flores* or Sublimate of a darkish gray. The Glass being dextrously cut asunder, we took out not only the filings of *Zinke*, some of which were melted into little globuls, but the *Flores* too, and yet weighing all these in the same Scales, we had us'd before, we found five Grains and somewhat better wanting of an Ounce. Which we the less wonder'd at, because of the continuance of the lately mention'd Exhalations emitted by the filed Mineral.]

EXPER. VII.

For more ample confirmation of the truth discover'd by what I have been reciting about Tin, I thought fit to try the like Experiment upon another Metal, which though of some-

somewhat more difficult fusion than Tin, I had reason to think might, if employed in a moderate quantity, and warily managed, be kept melted in Glass without breaking it. And accordingly having carefully weigh'd out four Ounces of good Lead cut before-hand into pieces little enough for the orifice of the Glass, I caused them to be put into a small Retort with a long neck, wherein was afterwards left but an orifice not much bigger than a pins head: Then leaving directions with the Laborant what to do, because I was my self call'd abroad, at my return he brought me together with the Glass this Account: That he had kept it over and upon the Coals two hours, or better, and then supposing the danger of breaking the Glass was over, he had sealed it up at the little Orifice newly mention'd, and kept it on the Coals two hours longer. Before the Glass (which I found to be well seal'd) was broken, I perceived the pieces of Lead to have been melted into a Lump, whose

ſurface was dark and rugged, and part of the Metal to have been turn'd into a dark-colour'd Powder or *Calx*; All this being taken out of the Retort, was weigh'd in the ſame Ballance, whereon the Lead appear'd to have gain'd by the Operation ſomewhat above thirteen Grains.

EXPER. VIII.

To ſhew that Metals are not the only Bodies that are capable of receiving an increaſe of Weight from the Fire, I thought fit to make upon Coral a tryal, whereof my Memorial gives me this Account.

[Little bits of good red Coral being Hermetically ſeal'd up in a thin bubble of Glaſs, after two Drachms of them had been weigh'd out in a pair of nice Scales, were warily kept at ſeveral times over and upon kindled Coals, and at length being taken out for good and all, were found of a very dark Colour, and to have gain'd in weight three Grains and about a half.]

EXPER.

EXPER. IX.

One Experiment there is, which, though it might have come in more properly at another place, is not to be omitted in this, becauſe it may invite us to conſider, whether in the foregoing Experiments, excepting thoſe made on Lead and Tin in ſeal'd Veſſels, there may not be more of the Fire adherent to or incorporated with the Body expos'd to it, than one would conclude barely from the recited Increments of their Weight. For having taken very ſtrong freſh Quick-lime provided on purpoſe for choice Experiments, and expos'd it, before the Air had time to ſlake it, upon the Cupel, to a ſtrong fire where it was kept for two hours; I found that it had increas'd in weight even ſomewhat beyond my expectation: For being ſeaſonably put into the Ballance, the Lumps that weigh'd, when expos'd, but two Drachms, amounted to two

Drachms and twenty-nine Grains; which makes this Experiment a pregnant one to our purpoſe. For by this it appears, that notwithſtanding a Body may for many hours, or even for ſome days, be expos'd to a very violent Fire, yet it may be ſtill capable of admitting and retaining freſh Corpuſcles; ſo that, though well made Lime be uſually obſerv'd to be much lighter than the Stones whereof 'tis made; yet this lightneſs does not neceſſarily prove, that, becauſe a burnt Lime-ſtone has loſt much of its matter by the Fire, it has therefore acquir'd no matter *from* the Fire; but only inferrs, that it has loſt far more than it has got. And this may give ground to ſuſpect, that in moſt of the foregoing tryals the acceſſion of the fiery Particles was greater (though in ſome more, in others leſs ſo,) than the Ballance diſcover'd; ſince, for ought we know, divers of the leſs fixt Particles of the expos'd Body might be driven away by the vehemence of the Heat; and con-

conſequently the Igneous Corpuſcles that faſtned themſelves to the remaining matter might be numerous enough, not only to bring the acceſſion of Weight that was found by the Scales, but to make amends for all the fugitive Particles, that had been expell'd by the violence of the Fire. And ſince ſo fixt a Body as Quick-lime is capable of being wrought upon by the Igneous *Effluvia*, ſo as that they come to be as 'twere incorporated with it, it may perchance be worth conſidering, whether in other calcin'd or incinerated Bodies the remaining *Calces* or Aſhes may not retain more than the bare Impreſſion (unleſs that be ſtretch'd to mean ſome participation of a ſubſtance,) of the Fire. Whether theſe Particles that adhere to or are mingled with the ſtony ones of the Lime may have any thing to do in the Heat and tumult that is produc'd upon the ſlaking of Lime, this is not a fit place to examine. And *though* by this Experiment and thoſe made in

in ſeal'd Retorts; which ſhew that what is afforded by Fire may in a Corporeal way invade, adhere and add Weight to even fixt and ponderous Bodies, there is a large Field open'd for the Speculative to apply this Diſcovery to divers *Phænomena* of Nature and Chymiſtry; *yet* I ſhall leave this Subject unmedled with in this place.

A DISCOVERY Of the PERVIOUSNESS OF GLASS To PONDERABLE PARTS OF FLAME.

With ſome Reflexions on it by way of *COROLLARY.*

Subjoyned as an Appendix *to his Experiments about* Arreſting *and* Weighing *of* IGNEOUS CORPUSCLES,

BY

The Honorable ROBERT BOYLE.

LONDON;
Printed by *W. G.* for *M. Pitt* at the ſign of the White Hart, over-againſt the little North Door of St *Paul*'s Church. 1673.

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A DISCOVERY OF The Perviouſneſs of GLASS TO *Ponderable Parts of* FLAME.

THAT I might obviate ſome needleſs ſcruples that may be entertain'd by ſuſpitious Wits upon this Circumſtance of our Additional Experiments, *That the Glaſſes employ'd about them were not expoſed to the Action of mere Flame, but were held upon Charcoals*, (which to ſome may ſeem to contain but a Groſſer kind of Fire:) And *that* alſo I might, by diverſifying the way of tryal, render ſuch Experiments *both* more fit to afford Corollaries, *and* more ſerviceable to my other purpoſes, I attempted to make it ſucceed with a Body ſo thin and diſingaged from

from gross matter as mere Flame is allowed to be, knowing, that by going cautiously with it to work, one might handle a Retort without breaking it, in spite of a violent agitation of kindled matter.

EXPER. I.

Supposing then that good common Sulphur by reason of its great Inflammability and the vehemency and penetrancy of its Flame, would be a very fit fuel for my purpose, I provided a small double Vessel so contrived, *that* the one should contain as many Coals as was necessary to keep the Sulphur melted; and *that* the other, which was much smaller, and shap'd like a Pan, should contain the Brimstone requisite for our Tryal; and (lastly,) *that* these two should be with a convenient Lute so joyned to one another, that all being clos'd at the top, save the orifice of the little Pan, (the fire and smoak of the Coals having their vent another way,)

way,) no fire ſhould come at the Retort to be employed, but the flame of the burning Brimſtone. Then two ounces of filings of Tin being heedfully weigh'd out, and put into a Glaſs-Retort provided for ſuch Tryals, and made fit to be eaſily ſeal'd up at the neck; when the time ſhould be convenient, the Sulphur (which ought to be of the purer ſort) was kindled, and the Glaſs by degrees expoſed to it; where it continued, as the Laborant inform'd me, (the ſmell of Brimſtone, peculiarly offenſive to me, forbidding me to be preſent,) near two hours before the Metal melted; after which he kept the Retort near an hour and half more with the Metal melted in it. Then bringing it me to look upon, I perceived a pretty deal of darkiſh *Calx* at the bottom, and partly too upon the ſurface of the far greater part of the Metal, which now lay in one Lump. The part of the Retort that had been ſeal'd being broken off, we firſt took out the *Calx*, and then the

the Lump, and putting them into the Scales, they had been formerly weigh'd in, found them to have made a very manifeſt acquiſt of weight, which, if both the Laborant and I be not miſtaken, (for the paper, which ſhould inform us, is now miſſing) amounted to four grains and a half, gained by the recited Operation. Afterwards, we being grown more expert in making ſuch Tryals, the experiment was repeated with the ſame quantity of filings of the ſame Metal: At the end of the Operation, (which in all laſted ſomewhat above three hours) having broken off the ſeal'd neck of the Retort, we found, that a good proportion of dark-colour'd *Calx* had been produc'd. This being weighed with the uncalcin'd part of the Metal, the two ounces we firſt put in appear'd to have acquir'd no leſs than eleven grains and a half (and ſomewhat better.)

Such Superſtructures, both for number and weight, may poſſibly in

in time be built on this and the like Experiments, that I ſhall venture to obviate even ſuch a ſcruple as is like to be judg'd too Sceptical. But I remember, that, conſidering upon occaſion of ſome of the Experiments formerly recited, that though it were very improbable, yet it did not appear impoſſible, that the increment of Weight, acquir'd by Bodies expos'd in Glaſs-veſſels to the Fire, might proceed, not from the Corpuſcles of Fire, but from the Particles of the Glaſs it ſelf, looſened by the power of ſo intenſe a Heat, and forcibly driven into the inclos'd Body; I was content to take a couple of Glaſſes, whereof one was ſhap'd into a little Retort, and having weigh'd them, and then having kept them for a conſiderable time upon kindled Coals, and then weigh'd them again, I could gather little of certainty from the Experiment, (the Retort at one time ſeeming to have acquir'd above half a grain in the fire,) ſave that there was no likelihood at all, that

ſo conſiderable an increaſe of weight, as we divers times obtain'd in cloſe veſſels, ſhould proceed from the Glaſs it ſelf, and not from the Fire.

EXPER. II.

Becauſe it ſeems evident enough, that, whatever Chymiſts tell us of their Hypoſtatical Sulphur, common Brimſtone is a body Heterogeneous enough, having in it ſome parts of an oyly or inflammable nature, and others acid, and very near of kin to the Spirits of Vitriol; I thought fit to vary our Experiment, by making it with a liquor that is generally reputed to be as Homogeneous as Chymiſts themſelves are wont to render any, I mean with a Spirit of Wine, or ſome ſuch liquor as will totally flame away without affording Soot, or leaving any drop of Phlegm behind it. In proſecution of this deſign, we carefully weighed out an ounce of filings of Block-Tin, and put them into a Glaſs-Retort, fit for the

the purpoſe, whoſe neck was afterwards drawn out to a great ſlenderneſs; and we alſo provided a conveniently ſhap'd metalline Lamp, ſuch as that the flame of this ardent Spirit might commodiouſly burn in it, and yet not melt nor crack it; which Lamp, though furniſhed with a Cotton wick, afforded no Soot, becauſe as long as it was ſupplied with liquor enough, it remained unburnt. Theſe things being in readineſs, the Retort was warily approach'd to the flame, and the Metal was thereby in a ſhort time melted. After which the Glaſs being kept expos'd to the ſame flame for near two hours in all, the ſeal'd *apex* of the Retort was broken off, and there appear'd to have been produc'd a not inconſiderable Quantity of *Calx*, that lay looſe about the remaining part of the Tin, which, upon its growing cold, was harden'd into a Lump. This, and the *Calx*, being taken out of the Retort with care, that no little fragment of Glaſs

ſhould at all impoſe upon us, was weigh'd in the ſame Scales as formerly, and found to have gain'd four grains and a half, beſides the Duſt that ſtuck in the inſide of the Retort, of which we reckon'd enough to make about half a grain more; ſo that of ſo fine and pure a flame as of this totally ardent Spirit, enough to amount to five grains was arreſted, and in good meaſure fixt by its operation on the Tin it had wrought upon.

EXPER. III.

For confirmation of the former tryal, wherein we had imployed the *Spiritus ardens* of Sugar, we made the like experiment with highly Rectified Spirit of Wine; only ſubſtituting an ounce of Lead inſtead of one of Tin. The event, in ſhort, was this; that after the Metal had been for two hours or better kept in the flame, the ſeal'd neck of the Retort being broken off, the external Air

Air ruſh'd in with a noiſe, (which ſhew'd the Veſſel to have been very tight,) and we found pretty ſtore of the Lead; for 'twas above ſeven ſcruples, turn'd into a grayiſh *Calx*, which together with the reſt of the Metal being weigh'd again, there was very near, if not full, ſix grains of increaſe of weight acquir'd by the Operation.

1. *N. B.* The Lump of Lead, that remain'd after the newly recited Operation, being ſeparated from the *Calx*, was weighed and cut in pieces, that it might be put into a freſh Retort, wherein it was again expos'd to the flame of Spirit of Wine, that I might ſatisfie my ſelf, whether probably the whole Body of the Lead might not, by repeated Operations, or (perhaps by one continued long enough) be reduc'd to *Calx*. And though, after the Retort (whoſe neck had been drawn out) had been kept in the flame for about two hours, it was, by the negligence of a Foot-boy, unluckily broken, and ſome of

the *Calx* loſt; yet we made a ſhift to ſave about five grains of it, (whoſe colour was yellowiſh;) which was enough to make it likely, that, if we had had conveniency to purſue the Operation to the utmoſt, the whole Metal might have been calcin'd by the action of the flaming Spirit.

2. *N. B.* And leſt you ſhould be induc'd by ſome Chymical conceits to imagine, that the particles that once belong'd to flame, did make more than a Coalition with thoſe of the Lead, and by a perfect Union were Really tranſmuted into the Metal whoſe weight they increas'd; I ſhall add, that (according to a Method elſewhere deliver'd) I examin'd the *ſeven ſcruples* of *Calx*, mention'd to have been made in the third Experiment, by weighing them in Air and Water, and thereby found, as I expected, that though the *abſolute* Gravity of the Metal had been increas'd by the particles of Flame that ſtuck faſt to it, yet this Aggre-

gate

gate of Lead and extinguiſh'd Flame had loſt much of its *ſpecifick* Gravity. For, whereas Lead is wont to be to Water of the ſame bulk, as about *eleven* and a *half* to *one*, this ſubtil *Calx* of Lead was to Water of the ſame bulk little, if at all, more than as *nine* to *one*.

Theſe are not the only Experiments I made of the Operation of meer Flame upon Bodies inclos'd in Glaſſes; but theſe, I ſuppoſe, are ſufficient to allow me to comply with my preſent haſte, and yet make good the *Title* prefixt to this Paper. For, whence can this increaſe of *abſolute* weight (for I ſpeak not of *ſpecifick* Gravity,) obſerv'd by us in the Metals expos'd to the mere flame, be deduc'd, but from ſome ponderable parts of that Flame? And how could thoſe parts invade thoſe of the Metal inclos'd in a Glaſs, otherwiſe than by paſſing through the pores of that Glaſs? But, becauſe I judge it unphiloſophical, *either* to be more careful that what one writes ſhould *appear* ſtrange, than *be* true;

or to be forward to advance the repute of Strangeneſs, to the prejudice of the Intereſt of Truth, though it be perhaps but a remote one, or a collateral one; I ſhall deal ſo impartially, as to ſubjoyn on this occaſion two or three ſhort Intimations, that may prove *both* ſeaſonable for Caution, in reference to the Porouſneſs of Glaſs, *and* give a hint or two in relation to other Things.

I do not then by the foregoing Experiments pretend to make out the Poroſity of Glaſs any farther, than is expreſt in the *Title* of this Paper; namely, in reference to ſome of the Ponderable parts of Flame. For otherwiſe I am not at all of their mind, that think Glaſs is eaſily penetrable, *either*, as many do, by Chymical Liquors; *or*, as ſome, by Quickſilver; *or*, as others, at leaſt by our Air: Thoſe opinions not agreeing with the Experiments I made purpoſely to examine them, as you may find in another Paper.

Again, if we compare the Increaſe

we

we obſerve to be made in the Weight of the Bodies that we expoſe to the naked Fire, and thoſe of the ſame or the like kinds that we included in Glaſſes, or ſo much as in Crucibles; it may be worth conſidering, Whether this difference in acquir'd weight may not give cauſe to ſuſpect, that the Corpuſcles, whereof Fire and Flame conſiſts, are not all of the ſame ſize, and equally agitated, but that the interpos'd Veſſel keeps out the groſſer Particles like a kind of Strainer, though it gives paſſage to the minuteſt and moſt active?

I offer it alſo to Conſideration, Whether this perviouſneſs of Glaſs, even to the minute particles that pervade it, and their adheſion to the Metal they work on, does neceſſarily imply Pores *conſtantly* great enough to tranſmit ſuch Corpuſcles? or, Whether it may not be ſaid, *that* Glaſs is generally of a cloſer Texture, than when in our Experiments the pores are open'd by the vehement Heat of the flame that beats upon it,

and

and in that ſtate may let paſs Corpuſcles too big to permeate Glaſs in its ordinary ſtate; and *that* this penetration is much aſſiſted by the vehement agitation of the Igneous parts, which by the rapidneſs of their motion both force themſelves a paſſage through the narrow pores of the Glaſs, and pierce deep enough into thoſe of the included Body to ſtick faſt there; (as hail-ſhot thrown with ones hand againſt a board, will paſs off from it, but being ſhot out of a Gun will pierce it, and lodge themſelves in it?) And I know a *Menſtruum* that does not work upon a certain Metal whilſt the liquor is cold, or but faintly heated, and yet by intending the Heat would be made to turn it into a powder or *Calx*, (for it does not properly diſſolve it.)

Perhaps it may not be amiſs to add on this occaſion, that though Glaſs be generally acknowledged to have far ſmaller pores, than any other matter wont to be implyed to make veſſels, that are to be expos'd to

to the fire; yet till I be farther ſatisfy'd, I ſhall forbear *both* to determine, whether the rectitude, that ſome Philoſophers ſuppoſe in the pores of Glaſs, as 'tis a tranſparent body, or rather in their ranks or rows, may facilitate the Perviouſneſs we above obſerv'd in Glaſs, *and* to conclude from the foregoing Experiments, that ponderable parts of Flame will be able as well to paſs through the pores of Metalline veſſels as thoſe of Glaſs. For though, with a ſilver veſſel, made merely of plate without Soder, I made two or three Tryals (of which you may command an account) in order to the reſolving of theſe doubts; yet by an accident, which, though it were not a ſurprizing one, was unlucky enough to defeat my endeavours, I was kept, for want of fit Accommodations, from bringing my intended tryals to an iſſue.

And now having endeavour'd by the foregoing Advertiſements to prevent the having unſafe Conſequences drawn

drawn from our Experiments; it remains that I briefly point at three or four *Corollaries* that may more warily be deduc'd from them. To which, if I get time, I may ſubjoyn a hint or two about further Inquiries.

COROLLARY I.

Confirming this PARADOX, That Flame may act as a Menſtruum, *and make Coalitions with the Bodies it works on.*

THE Experiments, we have made and recited of the permeating of Flame (as to ſome of its parts) through Glaſs-veſſels, and of its working on included Metals, may much confirm the Paradox I have elſewhere propos'd, That Flame may be a *Menſtruum*, and work on ſome Bodies at the rate of being ſo; I mean not only by making a notable Comminution and Diſſipation of the parts, but

but by a Coalition of its own particles with thoſe of the fretted Body, and thereby *permanently* adding Subſtance and Weight to them. Nor is it repugnant to Flames, being a *Menſtruum*, that in our experiment the Lead and Tin, expos'd to it, were but reduc'd to powder, and not diſſolv'd in the form of a Liquor, and kept in that ſtate. For, beſides that the interpos'd Glaſs hinder'd the Igneous particles from getting through in plenty enough; I conſider, that 'tis not neceſſary, that all *Menſtruums* ſhould be ſuch Solvents, as the objection ſuppoſes. For *whether* it be (as I have ſometimes ſuſpected,) that *Menſtruums*, that we think ſimple, may be compounded of very differing parts, whereof one may precipitate what is diſſolved by the other; *or* for ſome other Cauſe, I have not now time to diſcuſs. Certain it is, that ſome *Menſtruums* corrode Metals and other Bodies without keeping diſſolved all, or perhaps any conſiderable part; as may be ſeen, if you put Tin

in

in a certain quantity of *Aqua fortis*, which will in a very ſhort time reduce it almoſt totally to a very white ſubſtance, which, when dry, is a kind of *Calx*. And ſo by a due proportion of Oyl of Vitriol, abſtracted from Quickſilver by a ſtrong fire, we have divers times reduc'd the main body of the Mercury into a white powder, whereof but an inconſiderable part would be diſſoluble in water. And ſuch a white *Calx* I have had by the action of another fretting Liquor on a Body not Metalline.

And having thus clear'd our Paradox of the oppos'd Difficulty, my haſte would immediately carry me on to the next Corollary, were it not, that there is one *Phænomenon* belonging to this place that deſerves to be taken notice of. For, *whether* it be, as ſeems probable, from the vehement agitation of the permeating particles of Flame, that violently tear aſunder the Metalline Corpuſcles, or from the nature of the Igneous *Menſtruum*, (which being as 'twere percolated through

through Glaſs it ſelf, muſt be ſtrangely minute,) 'tis worth obſerving, how ſmall a proportion, in point of weight, of the additional adhering Body may ſerve to corrode a Metal, in compariſon of the Quantity of vulgar *Menſtruums* that is requiſite for that purpoſe. For, whereas we are oblig'd to imploy, to the making the ſolution of crude Lead, ſeveral times its weight of Spirit of Vinegar, and (though not ſo many times) even of *Aqua fortis*, 'twas obſerv'd in our Experiment, that, though the Lead was increas'd but ſix grains in weight, yet above ſix ſcore of it were fretted into powder, ſo that the *Corroſive* Body appear'd to be but about the twentieth part of the *corroded*.

COROLL. II.

Propoſing a PARADOX about Calcination and Calces.

Another Conſequence, deducible from our diſcovery of the perviouſneſs of

of Glaſs to Flame, may be this; That there is cauſe to queſtion the Truth of what is generally taken for granted about Calcination, and particularly of the notion, that not only others, but Chymiſts themſelves, have entertain'd about the *Calces* of Metals and Minerals. For, whereas 'tis commonly ſuppos'd, that in Calcination the greater part of the Body is driven away, and only the Earth, to which Chymiſts add the Fixt Salt, remains behind; and whereas even Mechanical Philoſophers, (for two or three of Them have taken notice of Calcination,) are of opinion, that much is driven away by the violence of the fire, and the remaining parts by being depriv'd of their more radical and fixt moiſture are turn'd into dry and brittle particles: Whereas theſe Notions, *I ſay*, are entertain'd about Calcination, it ſeems, that they are not well fram'd, and do not univerſally hold; ſince, at leaſt they are not applicable to the Metals, our Experiments were made on. For, it *does not* appear by

by our Tryals, that any proportion, worth regarding, of moiſt and fugitive parts was expell'd in the Calcination; but it *does* appear very plainly, that by this Operation the Metals gain'd more weight than they loſt; ſo that the main body of the Metal remain'd intire, and was far from being, *either* as a *Peripatetick* would think, Elementary Earth, *or* a compound of Earth and Fixt Salt, as Chymiſts commonly ſuppoſe the *Calx* of Lead to be. From which very erroneous *Hypotheſis* they are wont to inferr the ſweet Vitriol of Lead, which they call *Saccharum Saturni*, to be but the ſweet Salt of it *extracted* only by the Spirit of Vinegar, which does *indeed* plentifully enough concurr to *compoſe* it. Whence I conclude, that the *Calx* of a Metal even made (as they ſpeak) *per ſe*, that is, by fire without additament, may be, at leaſt in ſome caſes, not the *Caput mortuum*, or *Terra damnata*, but a Magiſtery of it. For, in the ſenſe of the moſt intelligible of the Chymical Writers, that is

properly a Magiſtery wherein the Principles are not ſeparated, but the bulk of the Body being preſerved, it acquires a new and convenient form by the addition of the *Menſtruum* or Solvent imployed about the preparation. And, not here to borrow any Argument from my Notes about particular Qualities, you may gueſs, how true it is, that the greateſt part of the Body, or all the radical moiſture is expell'd in Calcination, which therefore turns the Metal into an arid unfuſible powder; by this, That I have ſeveral times from *Calx* of Lead reduc'd corporal Lead. And I remember, that having taken what I gueſs'd to be but about a third or fourth part of the *Calx* of Lead, produc'd by the third Experiment; I found by a tryal purpoſely devis'd, that without any Flux-powder or any additament, but meerly by the application of the Flame of highly Rectified Spirit of Wine, there could in a ſhort time be obtain'd a conſiderable proportion of malleable Lead; whereof

whereof the part I had the Curioſity to examine, was true malleable Lead; ſo little was the arid powder, whence this was reduc'd, depriv'd by the foregoing Calcination of the ſuppo'sd radical moiſture requiſite to a Metal. The Conſideration of what may be drawn from this Reduction in reference to the Doctrine of Qualities belongs not to this place.

COROLL. III.

One uſe, among the reſt, we may make, by way of Corollary, of the foregoing Diſcovery, which is in reference to a Controverſie warmly agitated among the Corpuſcular Philoſophers themſelves. For, ſome of them, that follow the *Epicurean* or *Atomical Hypotheſis*, think, that when Bodies are expos'd in cloſe veſſels to the fire, though the Igneous Corpuſcles do not ſtay with the Bodies they invade, yet they really get through the Pores of the interpos'd Veſſels, and permeate the included

Bodies in their paſſage upwards; whereas others, eſpecially favourers of the *Carteſian* Doctrine, will not allow the *Atomiſts* Igneous Corpuſcles, which they take to be but vehemently agitated particles of Terreſtrial matter, to penetrate ſuch minute pores as thoſe of Glaſs; but do ſuppoſe the operation of the fire to be perform'd by the vehement agitation made of the ſmall parts of the Glaſs, and by them propagated to the included Bodies, whoſe particles by this violent Commotion are notably alter'd, and receive new Textures, or other modifications.

But our Experiments inform us, that, though neither of the two Opinions ſeems fit to be deſpiſed, yet neither ſeems to have hit the very mark; though the *Epicurean Hypotheſis* comprize ſomewhat more of the Truth than the other. For, though it be not improbable, that the brisk agitation communicated by the ſmall parts of the Glaſs to thoſe of the Body contain'd in it, may contribute much

to

to the effect of the fire; and though, by the ſmall increment of weight, we found in our expos'd Metal, 'tis very likely, that far the greater part of the Flame was excluded by the cloſe Texture of the Glaſs; yet on the other ſide 'tis plain, that Igneous particles were trajected through the Glaſs, which agrees with the *Epicureans*; and they, on the other ſide, miſtook, in thinking that they did but paſs through, and divide and agitate the included Bodies; to which nevertheleſs our Experiments ſhew, that enough of them, to be manifeſtly ponderable, did permanently adhere.

Whether theſe Igneous Corpuſcles do ſtick after the like manner to the parts of meat, dreſt by the help of the fire, and eſpecially roaſt-meat, which is more immediately expos'd to the action of the fire, may be a queſtion, which I ſhall now leave undiſcuſs'd, becauſe I think it difficult to be determin'd, though otherwiſe it ſeems worthy to be conſider'd, in regard it may concern mens Health,

to know, *whether* the Coction of meat be made by the fire, only as 'tis a very hot body, *or* whether it permanently communicates any thing of its ſubſtance to the meat expos'd to it: In which (laſt) caſe it may be ſuſpected, that not only the degree and manner of application of a fire, but the nature of its fuel may be fit to be conſider'd.

COROLL. IV.

The Experiments above recited give us this further Information, That Bodies very ſpirituous, fugitive, and minute, may, by being aſſociated with congruous particles, though of quite another nature, ſo change their former Qualities, as to be arreſted, by a ſolid and ponderous Body, to that degree, as not to be driven away from it by a fire intenſe enough to melt and calcine Metals.

For, the foregoing Tryals (taking in what I * lately deliver'd of the leſſen'd ſpecifick Gravity of calcin'd Lead) ſeems

* *Exp.* III. *N.B.* 2.

ſeems plainly enough to diſcover, that *even* the agitated parts of flame, minute enough to paſs through the pores of Glaſs it ſelf, were as 'twere entangled among the metalline particles of Tin and Lead, and thereby brought to be fixt enough to endure the Heat that kept thoſe Metals in fuſion, and little by little reduc'd them into *calces:* Which is a *Phænomenon* that one would not eaſily look for, eſpecially conſidering how ſimple a Texture that of Lead or Tin may be ſuppos'd to be in comparison of the more elaborate ſtructures of very many other Bodies. And this *Phænomenon*, which ſhews us, what light and fugitive particles of matter may permanently concurr to the Compoſition of Bodies ponderous and fixt enough, may perchance afford uſeful hints to the Speculative, eſpecially if this ſtrict Combination of ſpirituous and fugitive ſubſtance with ſuch, as being groſs or unwieldy, are leſs fit than organiz'd matter to entangle or detain them, be applied, (as it

to know, *whether* the Coction of meat be made by the fire, only as 'tis a very hot body, *or* whether it permanently communicates any thing of its ſubſtance to the meat expos'd to it: In which (laſt) caſe it may be ſuſpected, that not only the degree and manner of application of a fire, but the nature of its fuel may be fit to be conſider'd.

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may be with advantage) to those aggregates of spirituous Corpuscles, and organical Parts, that make up the Bodies of Plants and Animals. And this hint may suggest a main Inference to be drawn from the Operations of the Sun-beams on appropriated subjects, supposing it to prove like that of flame on Tin and Lead.

And now having dispatch'd our *COROLLARIES*, we might here inquire, Whether all the particles of Fire and Flame, that are subtile and agitated enough to penetrate Glass, and fasten themselves to included Bodies, be reduc'd by Ignition to the same nature, or else retain somewhat of their proper Qualities? Which Inquiry I have some cause not to think so undeterminable, as at first blush it may appear. For, *one of the ways*, that may be propos'd for this *Examen*, is already intimated at the close of the third Experiment, which shews, that we may compare the specifick Gravity of the *Calces* of the same

ſame Metal, made in Glaſſes by the operation of Flames, whoſe fuels are of very differing Natures. And I ſaid, *one of the ways*, becauſe 'tis not the only way I could name, and have partly tryed. But though I might ſay more concerning Expedients of this kind, and could perhaps propound other Inquiries that may reaſonably enough be grounded upon the hitherto recited *Phænomena* (and thoſe of ſome other like tryals,) yet I muſt not unſeaſonably forget, that the purſuit of ſuch Diſquiſitions would lead me much farther than I have now the leiſure to follow it.

ERRATA.

Pag. 44. *l.* 19. *r.* ſome Metals work; *pag.* 1. *in the Diſcourſe* about the Determinate Nature of Effluviums, *add the name of the Author, viz.* By the Honorable *ROBERT BOYLE.*

FINIS.

The Printer to the Reader.

IT hath been thought, it might be the Intereſt of the Reader, eſpecially Foreiners, to be advertiſed, That theſe Eſſays are already Tranſlating into Latin, and beginning alſo to be printed in that Language; which that it may duly be done, both as to this and the Author's other Writings, to be publiſht for the future, the greater care will be taken here, becauſe it hath been ſeveral times found both at home and elſewhere, that the Verſions made of them abroad, and not in the place, where in caſe of any difficulty the Author may be conſulted with by the Latin Interpreters, are often very defective, and not ſeldom injurious to the ſenſe he hath deliver'd them in. Which being conſider'd by thoſe that deſire to know the genuine ſenſe of the Author, 'tis preſumed, they will rather chooſe thoſe Verſions, which are made by perſons that have that advantage of conſulting him in any caſe of doubt, than ſuch

ſuch as ſhall mis-inform them; notwithſtanding the pretence of a cheaper rate of the Book.

Which being thus advertiſed, the Printer *taketh this opportunity of farther acquainting the* Reader *from the* Latin Interpreter, *that theſe Eſſays, to his knowledge, were ready and in the Preſs ſeveral Months before Dr.* Thomas Bartholin's Acta Philoſophica & Medica *appear'd in* England, *in which there are two or three paſſages that may ſeem of affinity with ſome to be met with in the latter part of the Papers about Experiments of* Arreſting the parts of Flame, *and of* making them Ponderable.

A Catalogue of the Writings

Publiſht by

The Honorable *ROBERT BOYLE.*

1. *Seraphick Love.* London, *for* Henry Herringman, 1660. *in* 8°.

2. *New Experiments Phyſico-Mechanical, touching the Spring of the Air, and its Effects.* Oxford, *for* Thomas Robinſon, 1660. *in* 8°. *In Latin:* Oxford; *for the ſame*, 1661. *in* 8°.

3. *Certain Phyſiological Eſſays; to which is added, The Phyſico-Chymical Eſſay about the Differing parts, and Redintegration of Saltpetre; as alſo, the Hiſtory of Fluidity and Firmneſs.* London, *for* Henry Herringman, 1661. *in* 4°. *In Latin*; London, *by the ſame*, 1661. *in* 4°.

4. *Some Conſiderations touching the Style of the H. Scriptures.* London, *for* H. Herringman, 1661. *in* 8°.

5. *The Sceptical Chymiſt.* London, *for* John Crook, 1661. *in* 8°. *In Latin*; London, *for the ſame*, *in* 8°. 1662.

6. *A Defence of the Doctrine touching the Spring and Weight of the Air, againſt the Ob-*

Objections of Franciſcus Linus. London, *for* Tho. Robinſon, 1662. *in* 4°.

7. *An Examen of Mr.* Hobbes *his* Dialogus Phyſicus de Natura Aeris; *with an Appendix touching Mr.* Hobbes *his Doctrine of Fluidity and Firmneſs.* London, *for* Tho. Robinſon, 1662. *in* 4°.

8. *Uſefulneſs of Experimental Philoſophy.* Oxford, *for* Rich. Davies, 1663. *in* 4°.

9. *Experimental Hiſtory of Colours.* London, *for* H. Herringman, 1664. *in* 8°. *In Latin:* London, *for the ſame*, 1665. *in* 12°.

10. *Hiſtory of Cold. To which is added, an Examen of Antiperiſtaſis, and of Mr.* Hobbes *his Doctrine of Cold.* London, *for* John Crook, 1665. *in* 8°.

11. *Hydroſtatical Paradoxes.* Oxford, *for* Rich. Davies, 1666. *in* 8°. *In Latin*; Oxford, *for the ſame*, 1669. *in* 12°.

12. *Origine of Forms and Qualities.* Oxford, *for* Rich. Davies, 1667. *in* 8°. *In Latin*; Oxford, *for the ſame*, 1669. *in* 12°.

13. *Free Conſiderations about Subordinate Forms.* Oxford, *for* Rich. Davies, 1667. *in* 8°. *In Latin*; Oxford, 1669.

14. *Continuation of New Experiments Phyſico-Mechanical touching the Spring and Weight of the Air, and the Atmoſphere of Conſiſtent*

ſiſtent Bodies. Oxford, *for* Rich. Davies, 1669. *in* 4°.

15. *Of the Abſolute Reſt of Solid Bodies.* London, *for* H. Herringman, 1669. *in* 4°. *In Latin*; London, *for the ſame*, 1672. *in* 12°.

16. *Several Tracts*; viz. *An Introduction to the Hiſtory of Particular Qualities: Of Coſmical Qualities and Suſpitions: Of the Temperature of the Subterraneal and Submarine Regions: Of the bottom of the Sea.* Oxford, *for* Rich. Davies, 1671. *in* 8°. *In Latin*; London, *for the ſame*, 1672. *in* 12°.

17. *Small Tracts*; viz. *Of a Diſcovery of the admirable Rarefaction of the Air, even without Heat: New Obſervations about the Duration of the Spring of the Air: New Experiments touching the Condenſation of the Air by meer Cold, and its Compreſſion without Mechanical Engins: The admirably Diffuſing Extenſion of the ſame Quantity of Air rarified and compreſſed.* London, *for* H. Herringman, 1670. *in* 4°. *In Latin*; London, *for the ſame*, 1670. *in* 12°.

18. *Of the Uſefulneſs of Natural Philoſophy, Tom.* 2. Oxford, *for* Rich. Davies, 1671. *in* 4°.

19. *An Eſſay about the Origine and Virtue of Gems.* London, *for* Moſes Pitt, 1672. *in* 8°. *In Latin*; London, *for the ſame*, 1673. *in* 12°.

20. *Se-*

Objections of Franciſcus Linus. London, *for* Tho. Robinſon, 1662. *in* 4°.

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19. *An Eſſay about the Origine and Virtue of Gems.* London, *for* Moſes Pitt, 1672. *in* 8°. *In Latin*; London, *for the ſame*, 1673. *in* 12°.

20. *Se-*

20. *Several Tracts, containing New Experiments touching the Relation betwixt Flame and Air, and about Explosions: An Hydrostatical Discourse answering some Objections of Dr.* Henry More: *An Hydrostatical Letter, dilucidating an Experiment about a way of weighing Water in Water: New Experiments of the Positive or Relative Levity of Bodies under Water: Of the Air's Spring on Bodies under Water: About the differing Pressure of Heavy Solids and Fluids.* London, *for* Rich. Davies, 1672. *in* 8°.

21. *Essays, of the strange Subtilty, the great Efficacy, and the Determinate Nature of Effluviums. To which are annext, New Experiments to make Fire and Flame Ponderable; together with a Discovery of the Perviousness of Glass.* London, *for* Moses Pitt, 1673. *in* 8°.

22. *A Dialogue concerning the Positive or Privative nature of Cold; by a* Member of the R. Society: *And a Discourse about the Saltness of the Sea; and another of a Statical Hygroscope; together with some* Phænomena *of the force of the Air's Moisture. To which is added a Paradox about the Natural and Præternatural State of Bodies, especially the Air.* London, *for* Rich. Davies, 1673. *in* 8°.